RAILWAY ORGANIZATION AND WORKING

RAILWAY ORGANIZATION AND WORKING

This volume is published under the auspices of the Advisory Board on Railway Education, whose co-operation with the University of Chicago has resulted in the development of the Chicago courses in railway organization and operation.

Railway Organization *and* Working

A series of lectures delivered before the Railway Classes of the University of Chicago

Edited by
ERNEST RITSON DEWSNUP

CHICAGO
THE UNIVERSITY OF CHICAGO PRESS
1906

Published October 1906

Composed and Printed By
The University of Chicago Press
Chicago, Illinois, U. . A.

PREFACE

This volume is a compilation of special lectures delivered before the University classes in railway transportation during the period extending from November, 1904, to May, 1906. It may be said in explanation that the University of Chicago, during the past two years, has undertaken, in association with a number of railways, the training of railway employees with the object of increasing their professional efficiency. To this end, courses have been conducted in a number of subjects bearing upon the traffic, auditing, operating, and other sides of the American railway. One feature of these courses has been the practical co-operation of railway officials in the form of special lectures. A large number of applications having been received for printed copies of these lectures, as many of them as practicable have been collected into the present volume. It is the regret of the editor that he failed to secure others equally as interesting and as instructive as those contained in the subsequent pages. The volume, being but a compilation of scattered lectures, lays no claim to a balanced treatment of the whole subject of railway transportation. There are several obvious omissions which were unavoidable under the conditions surrounding the preparation of the volume. Nevertheless, to those acquainted with the literature of railway transportation it will not need emphasizing that the book really occupies a unique place. The numerous aspects of the railway service which it treats, the plain and non-

technical way in which every subject is handled, the fact that more than a score of railway experts of the highest reputation have collaborated in its production, all combine to make the volume indispensable to the ambitious young "railroader" who desires to make sure his rise in the service by establishing it upon as broad a foundation of knowledge as possible. The lack of a concise treatment of the varied aspects of railway operation has been felt for a long time by railway men and the interested public.

It is also to be hoped that the book, and others of its kind that may follow, will have a stimulating effect upon the teaching of railway economics in our universities. The study of this volume ought certainly to give the student of railway economics a more vivid appreciation of the organization he studies.

But in arranging for the original lectures and in preparing them for this volume, the editor has had keenly in mind the influence it may exert upon the rank and file of railway employees, the men from whom our railway lieutenants, captains, colonels, and generals of tomorrow must come. The more efficient training these men can receive, the greater good will they be able to confer upon the community with whose interests their business is indissolubly connected. One may almost dare to affirm that, in the solution of the so-called railway problem, education is likely to play a more beneficial part than much of the legislation that attracts public attention.

The educational movements at Montreal, Chicago, and elsewhere are significant. The railways are feeling

the difficulty of finding men equal to the responsibilities of the present complex organization. They are beginning to realize the necessity of drawing into their service many of those bright minds that find their way into a frequently thankless professional occupation. Consequently, we find the railways increasingly anxious to learn what the colleges and universities of the land can do for them in this regard. Though hardly understood by all at present, to the writer it goes without saying that it is just as necessary and just as beneficial for the railway officer to be trained scientifically for his work as for the civil engineer for his occupation, the doctor for the practice of medicine, and the lawyer for the pursuit of law.

In the preparation of this volume, I am indebted first and foremost to the writers of the papers, and also to numerous others who have given me assistance. I am indebted to Mr. E. H. Fritch, Assistant Secretary of the Amercan Railway Engineering and Maintenance of Way Association, for the use of some of the diagrams appearing in the volume.

The index has been prepared by Mr. C. W. Schroeder and Mr. A. G. Caldwell, Fellows in Railway Transporation, of the University, and I am under obligation to them for the assistance given in this and other ways.

In an appendix I have included some papers written by students of the classes, which will be found instructive and will serve the purpose of indicating the practical nature of the educational experiment now being made by the University of Chicago.

E. R. D.

CONTENTS

DIAGRAMS

THE WORK OF THE LAW DEPARTMENT OF A RAILROAD COMPANY

BLEWETT LEE, GENERAL ATTORNEY, ILLINOIS CENTRAL RAILROAD

The reason why a special department is made of the legal work of a railroad company is simply that the amount of legal business is so great that, for its systematic transaction and economical management, such a department is necessary. This situation is not peculiar to railroad companies, but is the same with any corporations or individuals having a large amount of property or business. All property invites predatory attack by those who wish to obtain it from its rightful owners. The property of a railroad company is peculiarly exposed. Frequently its tracks traverse sparsely settled regions inadequately policed. Enormous quantities of goods are subject to its care, and may be lost by theft or accident. The nature of the railroad business is one which is extraordinarily provocative of litigation.

A large part of the work of a railroad Law Department consists in giving counsel either by conference or by written opinions. The number of opinions called for every day in a large railroad system is very considerable—so great, in fact, that it is usually impossible for the general officers of the company to supply them without distributing the work to subordinate attorneys. Frequently this is necessary for other reasons, as, for instance, the familiarity of local lawyers with the facts upon which an opinion is requested, or with the local law of the state or municipality which is involved.

The conduct of the internal management of a corporation which owns a railroad is peculiarly under the survey of the Law Department. When a railroad company is organized, it is necessary to obtain a charter from the state. In addition to the usual reasons for incorporating—which are generally to unite the resources of many individuals for a common purpose, to avoid the incident of the death of its members, and to limit the liability which they incur—a railroad company has an especial need of a charter for the following purposes. The right to take tolls must be granted by the state. Railroad companies are historically the successors of toll-roads, such as turnpikes, built by private capital; or, later, tramways upon which the public used their own vehicles and tolls were paid simply for the use of the way. Still later, railroad companies came to supply the carriages used upon their lines. This has not altered the principle that the state must consent to the taking of tolls. What is still more important, a railroad company must have the right to condemn land —that is, to compel the owner to part with it at a forced sale for a reasonable compensation. Without this right, the expense of procuring way-lands for any considerable line would be prohibitive. The state has the power to condemn land for public purposes, and this power, by charter, is given to the railroad companies. While originally a charter required a special act of the legislature, now in every state there are general laws under which, by filing certain papers and fulfilling certain conditions, a railroad charter can be obtained. The work of obtaining it belongs to the Law Department.

After the charter is obtained, by-laws must be drawn which provide for the conduct of the business of the company—for its meetings, officers, and internal management. The drafting and amending of by-laws from time to time is legal work. There is also the work of drafting the resolutions to be adopted at the meetings of the stockholders and directors of the company, and the preparation of the minutes for corporate meetings. Nearly all corporate action takes the form of written resolutions, and frequently such resolutions have to be prepared with great pains. In the case of consolidation of different railroad companies into one corporation, or the purchase by one railroad company of the road of another, the minutes of the meetings of the corporations involved are frequently very elaborate and carefully framed to accord with the statutes covering the transaction. There is also the preparation of the contracts of the company, which often are of the greatest importance. Leases of railroad properties have to be prepared, and must be drawn with care, so as to prctect the rights of both the lessor and the lessee. Agreements by which traffic rights are granted to one railroad company over the lines of another frequently involve much important detail. The preparation of mortgages of the railroad, securing bonds, calls for the greatest care. The financing of a railroad depends upon these instruments, and the most ingeniously elaborate provisions must be inserted therein in order to tempt capitalists to invest in the bonds, and to provide for them the security to which they are entitled.

The conduct of the business of a railroad company

requires the drafting of contracts of very varied character. Crossing contracts are often elaborate in their provisions, especially where an arrangement is made for the construction of an interlocking plant. The contracts for the construction of the railroad bed frequently involve great sums, and the most careful provisions are necessary to prevent litigation. The establishment of spur-tracks involves contracts for the protection of the railroad company against fire and other losses, and in the use of the spurs. Where the railroad company is not strong enough to purchase cars straight out, contracts of conditional sale of rolling-stock are necessary. Where way-lands are bought, deeds must be drawn. Leases have to be prepared of the lands of the company, not yet required for railroad purposes, which may be let to advantage. An enormous number of licenses must be drawn to parties who string wires above, or lay pipes or other structures beneath, the track. Where, for any reason, it is undesirable to commit the railroad company definitely to a given location, or time is necessary to examine land titles, options must be drafted for the purchase of land. Union passenger stations call for agreements of a complicated character. Elaborate leases of rolling-stock are sometimes necessary. Traffic arrangements between connecting roads are frequently embodied in written contracts. Contracts may be made to carry express, for the purchase of coal, for compressing and loading cotton, for the transportation of circuses, for the transfer of passengers and baggage between stations, and the like. There are forms of bills of lading to be pre-

pared, covering the contract of shipment of freight, with special forms for the transportation of live stock or explosives. Where railroads are subject to a foreclosure, reorganization agreements may have to be drawn. The use of bridges or terminals also gives rise to elaborate contracts.

Turning to the subject of litigation, it will be seen at the very outset that the condemnation proceedings necessary for the construction of the line will involve many suits. Damage suits on account of injuries to passengers or employees are unavoidable, and are apt to be very numerous; some involving fictitious, most involving exaggerated, too many involving real, injuries. Claims for injuries to live stock are likewise numerous, and stir up hostility toward the railroad companies in the public mind out of all proportion to the values involved. Fires caused by sparks from the engines give rise to frequent and very dangerous suits. A whole town may be burned by a fire started by the spark from an engine. Railroad companies are, as a rule, insurers of freight carried. Theft and accident, and especially fires, give rise to numerous claims, frequently of large amounts. The injury or delay of freight in transit is productive of many claims. The construction of the roadbed constantly gives rise to suits for damages by reason of overflow. Lost baggage contributes its quota of claims against the company. Such claims as cannot peaceably be adjusted ultimately give rise to suits, and even before suit is brought, the advice of the Law Department is constantly necessary in the process of adjustment. The company is constantly

harassed by garnishments of the wages of its employees on its lines, and the danger of double payment is to be guarded against. The arrest of wrongdoers against the company has to be made under legal advice, as, upon failure of any criminal proceeding, a suit for malicious prosecution against the company may be expected.

The relations of the company to the state make frequent calls for the services of the Law Department. Sometimes the defeat of hostile legislation in Congress or by state legislatures requires the services of the company's lawyers. The ordinances by virtue of which railroads are built in cities, their tracks elevated, and their various connections with local industries established, must be passed upon by the company's counsel. The subject of taxation is one involving continual controversy with the state, and frequently gives rise to litigation of tremendous importance. State railroad commissions not infrequently subject railroad companies to the most drastic regulations, and may keep the companies in a continual state of contest. Proceedings before the Interstate Commerce Commission have to be conducted, and frequently involve great labor and high technical skill in their preparation.

In regard to the organization of the Law Department it may be said that, as in the case of railroad organization generally, it varies greatly, and especially with the size of the company. It is very difficult even to select an organization which can be taken as a type. The highest legal officer of the company is usually called the "General Counsel," but may be called the

"General Attorney" or the "General Solicitor," although this latter title is frequently given to his immediate subordinate. He has, as a rule, superintendence of the entire Legal Department, and is frequently a lawyer of national prominence, or a man of influence with the powers that be. The position is one which calls for ability of a high order. The word "general" implies that the duties of the officer are not confined to a particular locality, but involve the whole line, or a considerable part of it. Where a railroad extends through a number of states, it is practically impossible for a lawyer to be familiar with the details of the legislation and decisions in all the states, and the necessities of the case require that in any state where a considerable portion of the company's lines are located there shall be a District Attorney, with jurisdiction over the lines in that state or a part of them. Sometimes a State Attorney is appointed, with authority over the Local Attorneys of the company throughout the entire state. In each county along the line there is usually a Local Attorney, whose business it is to try cases and to give advice for that county. These duties may even occasionally, though rarely, require his entire time and constitute his sole employment.

The work of settling claims and procuring evidence, and securing the attendance of witnesses, is imposed upon Claim Agents. It is their business to reach injured persons as soon as possible, and to endeavor to settle claims without delay. Even a short delay involves having to pay the claimant's lawyer as well as

himself. The statements of the various witnesses are taken and reduced to writing by the Claim Agent, for the purpose of enlisting the witnesses, as it were, on behalf of the company, and also of preserving the record of the facts before they are forgotten. The importance of the work of the Claim Agents in the settling of cases has never been appreciated. A rough estimate has been made that it is about three times as expensive to dispose of a claim by litigation as by amicable settlement. In some companies the Claim Department is part of the Law Department. Much is to be said in favor of this organization, especially in the case of personal-injury claims; some of the advantages being, that the effort to settle is continuous, instead of being dropped when suit is brought, and that the time lost in communication and getting in touch between the Law Department and the Claim Department is saved. Few subordinate officers effect so great a saving in the expenses of a railroad company as good Claim Agents, and a false economy in not having a sufficient number of them, or in not giving them sufficient time for their work, or in not securing men of proper intelligence and ability, is apt to result later in a very serious increase of the company's unavoidable outlays.

In conclusion, it may be remarked that, just as in medicine it is cheaper and more effective to prevent than to cure diseases, so in the conduct of the affairs of a railroad company it is very much better to consult the Law Department before taking a step than afterward.

THE PASSENGER DEPARTMENT

PERCY S. EUSTIS, PASSENGER TRAFFIC MANAGER, CHICAGO, BURLINGTON & QUINCY RAILROAD

The Passenger Department, some railway officials have said, is like the appendix—of no apparent use and a great deal of trouble. Some people say it is a bureau which makes rules and arranges train service expressly to annoy and inconvenience the public. There is provocation for both these statements.

In a general way, the public correctly understands that the Passenger Department is that which has charge of every detail relating to passenger traffic. From the point of view of the railway man, it is the department whose duty it is to obtain a part of the existing competitive passenger traffic, or to develop new business of the kind for the railway; and, as any department of the road is only a part of the whole, it must work in harmony with all other departments toward the success of the whole. There is, however, no well-settled plan of organization for the Passenger Department, no definition of its functions, and no uniform outline of its duties and responsibilities. On some railroads it can hardly be dignified with the title of "department," being merely a bureau or clerkship in charge of some details. On others, the General Passenger Agent merely has charge of getting passenger business for the company; and, judging from his actions, his chief intructions are to get business any way he can.

On most railroads the Passenger Department prints

the tickets and distributes them to agents, fixes the rate of fare, and advertises for patronage. The Baggage Department is usually a bureau of the Passenger Department; in fact, on some roads the head of the latter is the head of both. On some railroads immigration work is in charge of the Passenger Department, and on others it is a separate department. Some roads include, as a bureau of the Passenger Department, the Commissary, for the operation of dining-cars, and this sometimes extends to the operation or oversight of eating-houses. On a few railroads the General Passenger Agent also has supervision of the United States mail and the express traffic, each of which is a business of considerable importance and has a necessary connection with the passenger-train service.

On all railroads the head of the Passenger Department to some extent influences the character of the passenger-train service which is offered for public patronage; but, as before stated, his duties and responsibilities in this respect vary greatly on the different roads, as indeed they do with respect to every matter of importance, as well as in regard to minor details having to do with passenger traffic.

That the Passenger Department is an important division of the railroad is clear when we realize that there are 207,000 miles of railways in this country, carrying nearly 700,000,000 passengers annually on passenger trains running upward of 500,000,000 miles and earning a revenue for the railroads of close to $520,-000,000, of which more than 80 per cent. is for the transportation of passengers, and the balance is the

earnings from miscellaneous traffic, such as express, mail, and baggage; the total earning of passenger trains being approximately 27 per cent. of the total earnings of the roads.[1]

There is great variety in the conditions under which the Passenger Department operates. It is one thing in New England, New York, and Pennsylvania, where the population is 750 people to the mile of road, and a very different thing in the West—in Nebraska and Colorado, for instance—where the population is but 150 to the mile of road. In New England the passenger earnings of the railroads are more than 44 per cent. of the total revenue; on the New York, New Haven & Hartford Railway about 49 per cent. of the whole are passenger earnings. But on what is called the southwestern group of roads—those in Texas, Oklahoma, New Mexico, etc.—the passenger earnings are but 23 per cent. of the total.

There is a like wide difference in the passenger earnings per mile of road and the earnings per passenger-train mile, as shown in the following table:

	Passenger Earnings per Mile of Road	Earnings per Passenger Train Mile
New England roads, Group 1	$ 6,065	$1.27
New York, New Haven & Hartford Railway	11,268	1.42
Southwestern roads, Group 9	1,354	1.10
Missouri, Kansas & Texas Railway	1,274	0.85
Average for the United States	2,523	1.08

In territory where the population is dense and the

[1] The figures in this and the following paragraphs refer to the year ending June 30, 1903.

conditions are fixed by long experience, the public everywhere has passenger-train service more or less adequate and satisfactory, and the everyday study of the Passenger Department is to keep such existing traffic moving satisfactorily at the minimum of expense, and to increase the revenue by offering new and improved service. How very different are conditions in the West, where the population is less per mile of railway by 80 per cent! In one district or state the population is chiefly urban, with a large class of business men and wealthy people having need or leisure for travel—and money, of course. In another district there are few large cities, and the population is mainly engaged in agriculture—people with a fair average wealth per capita, it is true, but with little need or leisure for travel. It is one thing to increase passenger traffic where people have little money, leisure, or necessity for travel, and quite a different question where a good many people have all of these. In many parts of the United States, in districts larger than European kingdoms, we have railroads with but a small contiguous population, where everything, the railroads included, is in a pioneer state; and while people in such new settlements are, as a rule, good travelers, there are comparatively few of them to the square mile or to the mile of railroad, and the question of passenger-train service is not so much one of present profit as of the development of the territory for future profit.

In a business of such magnitude, conducted under conditions varying according to the size of the road and the territory which it serves, the difficulties are

many and the problems important. I will outline a few on one of the western railroads.

The first in importance is train service. The Passenger Agent soon learns that he may not run only such passenger trains as will earn the most money per mile of road at the least expense; the Freight Department would suffer if he did. In one place, for instance, the road would lose a great deal of live-stock shipments if the Passenger Department did not furnish an evening train on which the stock-shipper may return free from his market to his home—a train for which there is, perhaps, inadequate paying traffic. In another place, where a daily passenger train earns but little, as the towns are small and the district agricultural, the Passenger Agent must run a service which the traffic will not warrant; else the people will ship their merchandise in, and their products out, by rival roads. Moreover, if this district is not easy of access by passenger service for land-seekers and business men hunting new locations, it will not grow as it should. Thousands of miles of our western railways were built —in fact, are now located—in sparsely settled regions of this kind. The question of today's passenger-train service is not so much one of what will pay now as what will best develop the country for future profit.

Having fixed upon his train service, by whatever method, the Passenger Agent's next difficulty is that he cannot collect fare from all who ride. A host of employees are moved about from place to place free on passenger trains, that they may perform their duties in construction or repairing the road, and in transacting

the business of the railway. To a considerable extent their families are also transported free. All this utilizes the carrying capacity of the trains, which is charged to the Passenger Department. As a rule, no account is taken of this class of free business called "employees," but it is very large.

What is even worse for the Passenger Department is the other free business. There are a great many reasons for this free traffic. One, for instance, is found in the case of the stock-man, who commonly goes to market with a car or two of stock on a freight train, but returns home on a free drover's ticket on a passenger train. It is also common practice to give passes to newspaper-men along the line. Without at this time dicussing this free list in detail, it is sufficient to say that the aggregate is large. On a carefuly run railroad I have known it to be 10 per cent. of its entire passenger business, taking no account of the employees. On few roads does it run much lower than that, and on many it runs much higher. It does not follow that the issue of these passes is unbusinesslike or unnecessary, and it is only mentioned here to illustrate one of the difficulties with which the Passenger Agent has to deal in making a good showing for his department. No account is taken, in reviewing the results of the Passenger Department, of the free business carried for other departments on the road. The questions asked him are: "How much per mile of road have you earned? How many miles of passenger-train service have been run to accomplish that? What is the average

earnings per mile for each train? What is the average per train-mile?"

As a rule, the discussion of results starts with a rather poor average per train-mile, and the head officer immediately raises the question: "Are we not wasting money in running such fast and handsome through trains?" But a careful review of the average earnings of each train quickly leads to the discovery that the trouble with the general average is not with those trains, but with a host of trains earning far less than the average, which are run chiefly to protect the interests of the Freight Department, or not for present profit or real need now, but for the purpose of developing a new country.

Another difficulty presents itself in connection with rates. The manner in which we conduct all business in this country is sufficiently astonishing, and our railway business methods are not the least striking. It is, it must be, like our agricultural business, of wonderful vitality to stand the strain of so much that is foolish and wasteful in its conduct. To me, one of the most foolish things in the conduct of our railroads is the manner of making rates. The law in most states fixes a maximum passenger rate per mile, and an important function of the Passenger Agent is to make his reductions from this figure with good reason; that is, for the greater profit of the road. By the use of the legal rates per mile, or by agreement between competitive lines, or by some other method, a very reasonable and proper set of standard and regular rates is arrived at; but a lack of good business sense seems to be shown in

the matter of reducing them for cause. Rates are very sensitive. An apparently sensible and businesslike reduction from the standard rate may be made for the movement of some business in Illinois today, with the result of establishing a similar basis of rates later on in Nebraska, in a case where there is no good business reason for it. I have often referred to an extreme case, illustrating the sensitiveness of rates, which occurred some years ago. The roads from Missouri and southeastern Kansas made certain excursion rates to the Merchants' Fair, or fall festivities, in St. Louis. This led to other roads making other rates from territory contiguous to St. Louis and to other points; and the influence quickly spread until, as a matter of fact, a certain absurd and unbusinesslike reduction in rates was made from St. Paul to Boston, because certain apparently businesslike and sensible rates had been made from Joplin, Mo., to St. Louis!

It is in excercising this function of reducing rates that the Passenger Agent so often errs. In his effort to seek new traffic for his road by reducing the standard rates, he frequently fails to take account of the effect of such reduction upon all existing traffic, or the traffic of the future, in that or other districts in which he is interested. This unbusinesslike proceeding is not, however, peculiar to Passenger Agents, but is often practiced by Freight Agents, and by those higher officials to whom, as they are my superiors, I shall not refer more specifically.

The rate of fare between two points having been fixed by some means or other, there is no way of main-

taining it. It is maintained only so long as it is to the interest of each road to do so. The obligation on the Passenger Department to reduce rates for profit, and the inability in any way to maintain rates, is a constant source of trouble—one of the greatest we have. The public knows this, and often seeks to make it to the interest of one of several competing lines to cut the rate, sometimes by means of an offer to concentrate on one line the major portion of business—for instance, the transportation to a large convention of passengers who would otherwise divide their patronage among all the roads. More often, however, the suggestion to cut rates comes in the shape of a false, and perhaps dishonest, report that a competing line has offered a concession. There is no man so credulous of such false reports as is the average Passenger Agent; for, as there is no fixed cost for transportation, Passenger Agents often seek advantage over their competitors by cutting rates, secretly or otherwise, trusting to the Lord that each such cut will bring extra business to already scheduled trains, and will have no concurrent bad effect upon existing traffic nor upon the business of the future. In other words, dishonest travelers and shippers consider the railway a proper "graft," and the contracting agent a "soft mark;" and he is.

One might go on indefinitely describing the difficulties of conducting a Passenger Department on the average road, presenting important problems, differing on the different railroads and in the different territories which they serve; but, in the brief time at my disposal,

it seems to me better to outline my ideas as to what the Passenger Department of a railway should be.

In the first place, there is keen competition among the roads in almost every part of this country, notwithstanding all that we read about community of interests and mergers; and, in the second place, this is a day of specialties. I have just been reading an Englishman's notes on travel in this country. He seems to have been struck by our great versatility. He says we are horribly versatile, and is surprised at our unlimited exercise of the right of private judgment which, he says, not one man in ten is competent to exercise; and more to the same effect. These passing remarks of his are prompted by his experience on some of our railroads. He goes on to say that, in his opinion, our great versatility results in our merely putting the thing through—and occasionally we don't. To some extent, his comments are justified; but I think we are coming more and more, in our railway business, to follow the same definite and careful rules that people in other lines of business are pursuing. It is with this idea of care and definiteness in every branch of the business that I venture to make the following suggestions as to how a good Passenger Department should be conducted:

1. The head of the department should have real charge of the passenger-train service, and of all the traffic that is handled by it.

2. He should constantly confer, and co-operate thoroughly, with the Freight Department—the more important revenue department of the road—and arrange

the passenger-train service with the entire interest of the road in mind.

3. He should have no responsibility whatever for the movement, or what is called the Operating Department and should be required, in every particular, not only to co-operate with the Operating Department as with the Freight Department in arranging passenger-train service, but to leave the handling of it to the operating officials.

4. He should have a Rate Bureau, which should not have authority to make rates, but simply to compile tariffs upon bases laid down by the chief; which bureau should be the only official source of rate quotations.

5. His Advertising Bureau is important. A most ordinary piece of work from that department is the issue of the public time-tables, usually giving a list of agents who will explain what they mean. But real advertising, that which draws public attention to the road as a carrier, is quite an art. Much money has been spent in advertising which accomplishes nothing, and only recently have the roads commenced to specialize that bureau. Some of the roads which do this, however, while keeping strict account of all advertising paid for in cash, take no account whatever of the cost of advertising which is paid for in transportation. Naturally this results in the issue of advertising tickets in large numbers to buy advertising which is next to worthless. The chief should carefully block out, from whatever appropriation he has at his command for the year, what work is to be done by the Advertising Department in each special district, and how it is to be

done: so much in newspapers, so much in billboards, so much in booklets, folders, signs, maps, etc.

6. A soliciting force should be employed, composed of men who are posted about the road for which they work, and not merely selected because they are good talkers, or liars. It is necessary to travel constantly to give information to the agents who have to sell the tickets, and to call upon the intending passenger in response to inquiries.

7. An Immigration Bureau should be organized. The importance of this varies, it is true, on the different roads, but almost all western roads have sparsely settled, partly developed territory, and an Immigration Bureau is necessary for that reason. That a road's interests in that respect require careful attention is evidenced by the fact that an Indiana man will move to Texas or Montana, according to the manner in which he happens to be solicited.

8. The Baggage Department: Our system of checking baggage in this country is easy for the passenger and, all things considered, works very well; but the Baggage Department is necessary to keep it going straight.

9. The Commissary Department is, on a great many railroads, considered so special that it is not part of the Passenger Department. But as it does not pay expenses on any road, and brings business, or otherwise, according as to whether or not it is run to suit the traveler, it appears to me very necessary that it be just as much a part of the Passenger Department as is the Baggage Department.

10. Mail and express traffic should be a bureau of this department. True, the mail compensation is fixed by law, and the usual express arrangement is a contract for so much space, or a percentage of the express company's gross receipts; yet this traffic is moved almost wholly on passenger trains. Mail, express, and passengers all have their special needs on these trains—the passenger traffic, however, being the important part; and unless all three are considered jointly, something is going to suffer. Undue weight will be given to the claims of one to the detriment of the others.

Without attempting to go into details to the extent of suggesting how many titled assistants would be necessary to carry out such a plan, I have given this outline as much to show how the Passenger Agent should classify his business and duties, as to show what these duties and his responsibilities are. If the Passenger Agent has his organization and his responsibilities well outlined in some such way, he can readily control the business of his department. If it is not a success from every reasonable point of view, the fault is his alone. In case of failure, it will, I think, be found to be due to the fact that he does not get statements enough, and does not sufficiently study the business of the day. He allows too many subordinates to make rates for him, when he should himself see that every tariff, and every departure from a standard rate, is made for what appears to be good reason, after careful consideration; or he has a host of traveling agents in the field, at a large expense, from whom he requires no regular reports showing where they have been, what

they have been doing, and what the results are. He has arranged his train service on an extravagant basis, or in a manner unsatisfactory to the public, without proper conference with district and local passenger agents, superintendents, conductors, trainmasters, and other employees who are on the ground and can give the best advice. He may not receive—or, if he does, he may not study—the monthly statements showing the earnings per mile of every passenger train run on the road, compared with the past, and the receipts for ticket sales at every station. He may have spent several hundred thousand dollars in advertising, without any definite plan for its use where it is needed and will count. He probably has no time to study carefully the art of wording an advertisement to attract the public notice, and employs for this purpose a worthy man who does not know any more about it than he does. He may have issued millions of miles of free tickets during the year, without reckoning that it is an expense, with the result that, as he placed no value upon what he gave, he got little value in return.

These may appear to be exaggerations of the faults and difficulties in the conduct of a Passenger Department. They are only the leading mistakes we make, and I mention them deliberately and advisedly.

RAILROAD ADVERTISING

CHARLES S. YOUNG, IN CHARGE OF ADVERTISING, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

Railroad advertising of today, like "all Gaul," may be divided into three parts: advertising to the traveling public, advertising to agents of the home road, and advertising to agents of connecting roads.

The church will pardon the illustration if railroad advertising to ticket agents be likened unto home and foreign missionary work. Both are important, and, as with other missionary work, it is always a question of whether more money should be spent in home or in foreign missions.

Suppose we consider ourselves away from home, and take up foreign missions first. Until a few years ago commissions were paid agents of connecting lines for business routed by them over what we may call "home lines." Those commissions have been abolished, and there is nothing of that nature now to influence such agents in sending business over the home line. Therefore there is a great need for interesting the agents in the home line and in its train service. There are a number of different methods in vogue for advertising train service to ticket agents of connecting lines. In all of these methods the mail plays an important part, and the post-office reaps a big benefit. The mailing-card and mailing-leaflet are perhaps the most common forms.

Mailing cars are sent, by many lines west of Chicago to ticket agents of lines east and south of Chicago, and to ticket agents of lines west of the western termini of the Chicago lines. These mailing cards emphasize superiority in train service, direct connections, low rates, or other features in which it is hoped to interest the agents of connecting lines. A few of these, picked up at random from our sample-case, may serve as an illustration of what goes through the mail to these agents. One of them calls attention to a low rate to California. The address is placed on the reverse side by addressograph machines. The address does not include the ticket agent's name, but reads for instance, "Ticket Agent, Pennsylvania Railroad, Harrisburg, Pa.," so that any change in the ticket agent there will not necessitate a change in the addressograph chains. Another one calls attention to President Roosevelt's remarks on laying the corner-stone of the new gateway to the Yellowstone Park; also to the choice of routes offered by the Chicago, Milwaukee & St. Paul Railway. Still another deals with the possibilities of making money in the cattle business in South Dakota. Probably very few of the ticket agents east or south of Chicago would or could take advantage of that opening themselves, but they are likely to receive requests for information regarding such openings. In all of these the rate is the point emphasized, and the name of the line and the service of that line are made subordinate features.

To vary the monotony of mailing-cards, a leaflet is occasionally used. For instance, a leaflet, printed in four colors illustrating the autumn foliage of the Rocky

Mountains, has been used to call attention to the train service between Chicago and Denver in connection with the attractions of Colorado as an ideal autumn resort.

An incident that took place in connection with the preparation of a leaflet calling attention to a tourist-car line via the St. Paul road from St. Paul and Minneapolis to Kansas City and California, shows how important it is to watch little things in railroad printing. The figure of a small Chinese boy occupied the lower left-hand corner, and the compositor elected to display the name of the General Passenger Agent just below it. We saw the combination just in time to make the change and to escape trouble.

A card, showing the train service between Chicago and about six or eight prominent summer resorts in Wisconsin and Michigan, and advertising the train service between Kansas City and Chicago, was sent to ticket agents of connecting lines south and west of Kansas City, where the climate is rather torrid in the summer time, in the hope that agents, by the use of these cards, would be able to answer inquiries regarding good summer resorts in the northland.

Aside from mailing-cards and leaflets, the abundant and regular distribution of time-folders among agents of connecting lines is an important work. Agents, we are told, will prefer a line whose folders come to them regularly. Most lines issue their folders on the first of each month, and, if agents of connecting lines can know absolutely that they will receive a folder from a certain line between the first and fifth of each month, for instance, they will have a friendly feeling for that

line merely for the co-operation it renders them by giving the information needed.

Books descriptive of various resorts and sections of the country are sent in limited quantities. At the larger points on connecting lines the ticket agent may receive a framed picture or a framed wall-map showing the system. Newspaper clippings, and page and half-page advertisements from newspapers, are also sent to ticket agents of connecting lines to remind them of some feature of the passenger service or of some bargain in rates. The use of back pages of newspapers, not only for the purpose of carrying page advertisements to the regular subscribers of the paper, but also to serve as mailing-slips to ticket agents of connecting lines, has become common. In a recent issue of the *Chicago Tribune* there appeared an advertisement on the subject of larger sleeping-car berths. On the opposite page there was an editorial on the same subject. The advertising railroad printed a red check-mark over the editorial, and a red hand pointing to the advertisement on the opposite page. Ten thousand copies of the paper were then mailed to agents of connecting lines.

All of this work—the mailing of leaflets, cards, and newspaper clippings to ticket agents of foreign lines—like all other foreign missionary work, has to be followed up by personal effort; in railroad work, by Traveling Passenger Agents. Of course, it is impossible for these to see all the agents or all the coupon ticket agents. They report to the General Passenger office as to the receipt of this advertising matter in their respective territories; and if they state that adver-

tising is not received, investigation is started to ascertain which link in the chain is broken.

Coming home from foreign missions, to missionary work among agents of the home line, I shall quote a few paragraphs from an advertising circular issued by the St. Paul road, which, I think, will indicate some important features of this side of railroad advertising:

TO ALL AGENTS

The object of advertising by this company is to increase its passenger business. It is important to keep this fact well in mind.

Newspaper advertising.—Both display and reading notices are provided for by our newspaper contracts. We expect to receive this advertising as the paper expects to receive transportation named in contract. Any failure to secure advertising requested should be promptly reported to your Division Passenger Agent.

Drop out-of-date advertising.—Out-of-date advertising is worse than no advertising at all. Cut it out. Recent inspection of papers carrying our advertising on transportation basis shows a surprising amount of advertising for events that have passed. Publishers of newspapers are prone to allow a notice once inserted to run indefinitely. It is easier to do so than to change copy. The interests of the advertiser demand frequent change of copy, and you represent the advertiser. Vigilance is the price of good advertising, and you will probably find it necessary frequently to call the attention of newspapers to the fact that our advertising must be published according to directions, and under no circumstances after the latest date given for insertion. You must give the newspaper dates for the advertisements.

Business follows advertising.—Wherever and whenever possible, inquiries resulting from advertisements should be promptly followed up with a view of securing the business. Following up inquiries forms the connecting link between advertising and the sale of tickets.

Distribution of booklets.—Booklets descriptive of resorts on the lines of this company and of points reached by its lines are issued to promote business. They will be forwarded to agents on request of Division Passenger Agents, but should be distributed with judgment. They are expensive, and are intended for those likely to travel.

Publication of news items.—From time to time news-slips containing current items of railroad news will be sent you for publication in newspapers with which we have advertising arrangements. They will be carefully prepared from a news standpoint, and the advertising feature almost eliminated. If the editor does not care to publish them as news, his action will have no effect on his advertising contract with this company.

Friendship with editors and reporters.—In delivering these items and advertising, and in handling transportation requests, it is urged that agents maintain a friendly attitude toward newspaper-men. The St. Paul road has received thousands of columns of complimentary publicity from newspapers, and expects to receive a great deal more. This service will be increased, and our advertising handled in a better manner, through the courteous treatment of newspaper-men by employees of this company.

Advertising to be avoided.—This company has discontinued advertising in programs, booklets, souvenirs, catalogues, directories, special editions of papers, and in novelties of all kinds. We will rely chiefly on the distribution of our own advertising matter, and timely advertising in newspapers, to help the agents sell more tickets.

Co-operation in advertising.—Suggestions for advertising, and for the improvement of our advertising, will be cordially received and carefully considered by the General Passenger Agent. It is not possible to adopt all the advertising plans submitted to this department, but frequently an agent has an opportunity to call attention to an advertising feature that may increase passenger earnings, and that is what we want. If in doubt about any advertising matter, do not hesitate to consult your Division

Passenger Agent or the General Passenger Agent. They will help you.

It is doubtful whether there is any class of advertising so important to the railroad as newspaper advertising. The publication and distribution of time-table folders is the only branch of the work that can be seriously regarded as competing with newspaper advertising for first place. The growth of newspaper advertising by railroads during the last few years has been most remarkable. In every case where results have been traced, the increase in ticket-sales has borne a close relation to the increase in newspaper advertising. This growth has been largely at the expense of novelty advertising. With the progressive railroads the day has gone by when penknives, rulers, ink-stands, envelope-openers, clocks, and other forms of novelties were used for extracting money from the railroad treasury for investment in advertising.

Of almost equal importance is the advertising in magazines and weekly publications of national circulation. For prompt presentation of a subject of travel or immigration to the entire country, no class of publications approaches these in value to the railway advertiser. A small proportion of railway advertising in the magazines and principal weeklies is paid for in advertising transportation, but the bulk of it in cash.

Within the last few years several railroads, notably those with tracts of undeveloped land to advertise, have used the cheaper weeklies and monthlies, known as "mail-order papers," to great advantage. For reaching the rural readers, who are in the great majority in this

country, these papers are in a class by themselves. Advertising designed to attract immigration into a certain field is therefore apt to be most effective in these papers. Mr. J. M. Campbell, who now advertises Ivory Soap, and who formerly established a new and enviable record in advertising the Rock Island System, recently said he thought the immigration advertising published by the Rock Island in mail-order papers had proved to be the best advertising ever done by that railroad.

Some railroads place their newspaper and magazine advertising through advertising agencies. Other lines prefer to have the advantage of dealing directly with the newspaper, and forego the slight financial saving made possible by placing the work through an agency. With the metropolitan newspapers most of the display advertising is paid for in cash, and most of the reading notices in transportation. Both display advertising and reading notices in papers of the smaller cities and towns are paid for in transportation.

The advertising in country papers along the lines of the Chicago, Milwaukee & St. Paul Railway is handled by the General Passenger Department in Chicago, through the several Division Passenger Agents. The copy is written and sent out from Chicago, but the checking of advertisements is done by the Division Passenger Agent, who, in turn, takes up with the publication, either directly or through the local agent, the question of omission of the advertisements, wrong insertions, or other failure in service.

The publication of news matter concerning a railroad that will favorably advertise the road is secured,

occasionally in the metropolitan press and more frequently in the country press, by the modern railroad advertising department. The news may concern the installation of a new train, the opening of an Indian reservation to settlement, a particularly fast run, or any one of the large number of events that are frequently happening in railroad circles, which the papers are glad to handle as news matter, if furnished with the facts sufficiently early.

Coupon advertisements have been used by railroads more and more during the last few years. Especially is this the case with advertising that is to be followed up. For instance, low rates to South Dakota, to which state immigration is now strongly directed, is a subject that has been pushed in this way, and with profitable results. These coupon advertisements have resulted in a greater measure of advertising going to papers with large circulation. A count of coupons invariably shows that the greatest number is received from papers of great circulation, reaching the middle classes, rather than from papers of a higher quality, but of limited circulation. On the other hand, the readers of the higher quality papers are not likely to cut out coupons. Many big advertising campaigns in the last five years have been directed to the great middle class, and, for that reason, coupon advertisements have shown a growth in railroad advertising.

Railroads make use of bulletin-boards, flyers, window-signs, and electric signs in their advertising work. Many railroads use electric signs for night display in their city ticket offices. Bill-boards, with eight- and

twelve-sheet posters, are frequently employed, and painted bulletin-boards are used in the larger cities. The distribution of framed maps and pictures—such as are seen in hotels and ticket offices—and of transparencies, is a common practice. Street-car advertising is often met with in larger cities, many railroads using double-space cards. Most street-car advertising is specially directed to some feature prominent at that particular season of the year.

With reference to the booklet form of railroad advertising, the copy is generally prepared outside the department. For illustration, take the case of the booklet entitled *Lake Lore,* issued in June, 1904. Work on the book was commenced in April, 1903. Arrangements were made with Mr. Forrest Crissey to write it, and he spent a good portion of one summer visiting the resorts described. Another book, *Summer Homes,* gives a list of summer resorts on the lines of the Chicago, Milwaukee & St. Paul, with information regarding hotels, boarding-houses, rates, etc. A larger quantity of the latter booklets is put out, as the cost of production is considerably less.

The time-table folders are generally prepared, printed, and distributed by the Advertising Department. There are nine forms of folders issued by the St. Paul road; but the tendency is to cut down the number to one or two forms.

Through the editorial end of the newspaper, railroads endeavor to secure the publication of news items. These come from various sources, but, like most copy, are finally handled by the Advertising Department. As

an illustration, I may mention one which first appeared in the *News* of Chula, Mo. It was noticed, reprinted in slip form, and one of these slips was inclosed in all mailing matter from all departments of the railway, and from all outside agencies, for several months. It has been reprinted by over 3,000 papers, and is still going.[1]

The lecture is a popular form of advertising with some railroads, especially western lines. For instance, a number of lectures on the Grand Cañon are being delivered throughout the country. These call attention to the natural scenery, and the advantages obtained through traveling via the particular lines mentioned. There also are a good many lectures on Colorado, California, and Yellowstone Park. Inquiries from people who hear the lectures are furnished the railroads,

[1]A GLEAM OF SUMMER SUNLIGHT

A SURE 'NUF HURRY UP TRAIN BETWEEN CHICAGO AND KANSAS CITY

The new train on the Chicago, Milwaukee & St. Paul Railway passed through Chula for the first time Sunday night, about three hours after dark. There was no hesitation at Chula town, at least none perceptible. There are no high places in Chula town, hence we question whether she ever touched the track. She just ripped a great fiery hole in the darkness and left the atmosphere heated steam-hot for a second; then whistled for Niantic or Chicago—we are not certain which. If "Central" had not been closed, we would have telephoned to Chicago to see if she hadn't run clean through the Union Station. She is sure 'nuff a "hurry-up train." Chicago is only about three miles up the track now. She is a gleam of summer sunlight, vestibuled and electric-lighted from the cowcatcher clear back a hundred yards behind the last coach. She is knee deep with velvet carpets, and her cushions are as soft as a girl's cheek. She is lighted to a dazzle and heated to a frazzle. She was built to beat the world, and her gorgeous splendor makes us chuckle to think we have a pass on her. She goes so fast that the six porters look like one big fat nigger. She is called "The Southwest Limited." She stops, going both ways, at Chillicothe, and you can get on her there, but, *you'll have to hurry*.

and they are followed up by descriptive booklets and folders.

The story of two advertising campaigns, very briefly told may be of interest. In July, 1904, the Rosebud Indian Reservation in South Dakota was opened for settlement. The St. Paul road first brought the matter to the attention of the public through an interview in the *Chicago Journal.* The interview contained the statement that between 50,000 and 100,000 people were expected to take advantage of the opening. These figures caused some astonishment, and the interview was given considerable publicity on that account. Descriptive folders, with maps and flyers, were printed and distributed liberally in the East and Central West. A timely Indian sketch was used for all advertising on the Rosebud opening. It was reproduced page-size in black and white in fifty of the best newspapers along the lines of the company. The *Saturday Evening Post* of June 9 of that year very opportunely came out with a page-and-a-half article, written by Mr. F. A. Miller, General Passenger Agent of the St. Paul road. It was good reading matter, and, in view of the fact that the circulation was something more than a half million copies, it is not surprising that the railway gained a great deal of advertising through it. Although the St. Paul road was more distant from the reservation than its principal competitors, it received the lion's share of the business.

In placing "The Southwest Limited"—a new train between Chicago and Kansas City—in service in December, 1903, an excellent opportunity was offered

for advertising. This was done with folders, blotters, and eight-sheet posters throughout Texas, Indian Territory, Oklahoma Territory, portions of Missouri, Kansas, and Colorado, and in and about both Kansas City and Chicago. One train was started three days in advance, and exhibited in towns along the line. The train was a half-day late getting to Kansas City, because of the great crowds that came out at local stations to see the new equipment. Street-car ads, in addition to newspaper display and mailing-cards to agents of connecting lines, were used to celebrate the day the train was one year old, and, so far as we know, it was the first train in America to a have birthday party.

In addition to direct passenger business, there is the land and immigration advertising to be handled, and publicity matters in connection with the work of development along local lines—of the greatest importance among western railroads. The St. Paul road, in September, 1903, at a time when some unfair crop stories had started about South Dakota, sent a party of newspaper correspondents to investigate these stories; with the result that it secured the publication of several hundred columns showing actual crop statistics, wih splendid results to South Dakota.

Most railroads have yearly advertising appropriations. Those of the western lines range from $50,000 to $350,000 in cash, and double these amounts in transportation.

The number of employees in the advertising departments of Chicago terminal lines range from a half-

dozen to fourteen. In the case of the Chicago, Milwaukee & St. Paul Railway there are nine. This includes a time-card clerk, who is responsible for the correctness of every figure in the time-tables showing the arrival and departure of trains for a system of over 7,000 miles. The principal folder contains seventy-two pages, and is issued once a month.

In conclusion, I think the work of real advertising by railroads has just started. There is still a great deal to be done, and there are excellent opportunities in this field for young men of ability and energy.

SUBURBAN PASSENGER SERVICE

W. L. SMITH, ASSISTANT TO THE SECOND VICE-PRESIDENT, ILLINOIS CENTRAL RAILROAD

The Illinois Central Railroad system enjoys the reputation, not only among professional railroad men, but among all who are well acquainted with railroad operation, of conducting the best suburban railroad service in the world.

What probably first attracted the eyes of the world to this service was the wonderful record it made during the World's Fair in Chicago in 1893. Its achievements during that period were known and discussed, especially by practical men, all over the civilized world, and have been talked about until the present day. From May 1 to October 31 of that year the Illinois Central carried, without the loss of a single life, or even an accident of any consequence, 18,339,184 passengers. When these figures are realized, and it is considered what was required in the way of train movement and service, this result is almost beyond belief. Nothing nearer perfection has ever been known in the annals of railroad operation. More amazing, however, even than this is the fact that on one day during the Fair—Chicago Day—this road safely handled 505,125 passengers—more than one-half of a million people, or about one-fourth of the entire population of this great city at the present time.

From reliable sources it has been ascertained that

the total number of passengers carried, at the present time, by suburban lines in the United States is about 135,000,000 per annum. Of these the Chicago lines carry approximately 29,000,000—not far from one-fourth of the entire number. The Illinois Central alone carries about 15,000,000, which is over one-half of the whole number carried in Chicago, and nearly 12 per cent. of the total number carried in the United States.

Having thus gained, from reliable statistics, an idea of what the suburban carrying roads have done, and what they are "up against"—to borrow an expressive slang phrase—let us next consider briefly some features of the manner in which suburban service is performed, taking as a basis—and I believe the best—the operation of the Illinois Central at Chicago. I have been emboldened to say the "best" partly by a remark made to me only recently by the President of the great Rock Island system, who knows a great deal about suburban service, as well as about all other branches of the railroad business. As he sat in one of our suburban cars, it gave me great pleasure to hear him say, with positive emphasis, that our suburban service was "the very best in the country."

It has been said that railroads pave the way to civilization. With as much truth it may be asserted that suburban service, as much, or possibly more, than any other one factor, builds up the great cities of the world. The principal requisites of such service are safety, comfort, and speed, in the order named.

The Illinois Central runs over three hundred suburban trains daily in Chicago, and handles safely from

40,000 to 50,000 passengers each day, over a total of fifty-six miles of suburban lines. By far the larger percentage of that number is carried between the hours of 7 and 9 o'clock in the morning, and 5 and 6:30 o'clock in the evening. The average train mileage per month is about 100,000, and as each train averages nearly five cars, this is equivalent to a car mileage per month of approximately 500,000, or 6,000,000 car-miles in one year. What this means to a city of two million or more people, in their daily and nightly pursuits of business and pleasure, can hardly be estimated.

The Illinois Central has eight tracks over nearly the entire territory in which it operates suburban trains. Of these tracks two are used for regular passenger trains, two for freight trains, two for suburban express trains, and two for suburban local trains. Of course, each track is used by trains of the classes mentioned running in the same direction. These tracks are laid with the heaviest and best steel rails, and every inch is carefully inspected day and night to keep them in as nearly perfect condition as human agency can accomplish. With a perfect roadbed, block signals, interlocking switches, and elevated tracks for miles, without crossings of any kind to interfere with the movement of trains, it is possible to make the highest speed, and with almost absolute safety.

During the rush hours in the morning and afternoon, suburban trains arrive at and depart from Randolph Street about two minutes apart; and, to get a good idea of the perfection of the system under which they are operated, one should notice, at one of the inter-

mediate stations, how both local and express trains closely follow each other, receiving or discharging their "precious cargoes of humanity" almost in a constant stream. From experience and observation, Chicagoans do not appreciate this service more than during the long, cold winter months, when they can, almost without exception, find these trains on time, and the cars as warm and comfortable as the home fireside. I have heard a number of persons say that they find this travel a real recreation, during which they read the newspaper, and find a few minutes for pleasant diversion from business cares. Some of the more sentimental refer to the scenic features of the great lake, with its various beauties for many miles, on one side, and the great city of Chicago, with its "towering monuments" and "stately mansions," on the other.

As "in each life some rain must fall," so of this suburban transportation, which many men of many minds and of massive brains have striven to perfect, some will complain, not stopping to draw the "deadly parallel," as the newspaper-men say, between such service as we are here discussing and other kinds which might be mentioned, did delicacy not forbid. When one can and does travel for miles with the comfort and safety here described, there should be no fault found with the time. The railroad furnishes the maximum facilities for the prompt and safe movement of passengers, according to their general daily habits of coming and going, so to speak, but at times the people seem to come all at once, and, as they want to go in the same direction, the train is crowded, and some fail to get a

seat. This inconvenience, however, lasts only a few minutes at most. As usual, there are two sides to the problem. On a certain evening, a short time ago, there was a great crowd at the Van Buren Street station. A local suburban train, with three large side-door cars, each with a seating capacity of one hundred, came along. Every car was filled until there was no standing room, and the conductor said he had over five-hundred passengers. I was one of the number. I knew that another train was not far behind, and got off at the first station. In less than five minutes another train, with identically the same equipment and capacity, followed, with a total of less than one hundred passengers. I think this illustration explains itself.

The successful handling of the World's Fair traffic, mostly by side-door cars, resulted in the invention by our company of a greatly improved side-door car, a number of which have recently been put into regular service. The following is a partial description of it: steel construction throughout of the underframe and upper frame, giving greater protection to the passengers against accidents and from fire; a floor plan combining with transverse seats an aisle on each side of the car, affording access to every part of the car from either side; side-doors which slide within the walls of the car, and end-doors with vestibules connecting all the cars, affording access from within to every part of the train; carrying capacity far in excess of any other car, with seats for the largest number of passengers; perfect system of lighting, heating, and ventilation; electric connection between the side-doors of the entire train

and the locomotive, giving signal automatically to the engineman of the opening and closing of doors; absolute control by the trainmen of the opening and closing of the side-doors; inability of passengers to expose themselves to danger; rapidity of loading and unloading passengers without disturbance of those who remain in the cars; distribution of passengers throughout the car or the entire train after it has resumed motion; distribution of passengers evenly on station platforms, with assurance that the train can be entered conveniently at any point; short stops at stations, with consequent improved train schedules.

This side-door car is seventy-two feet long and ten and one-half feet wide. It has a seating capacity of one hundred. The "old-style cars," as they are now called, are of two sizes, with a seating capacity of forty and fifty-six, respectively. So rapid is the method of operating the side-door car that one hundred passengers have been discharged from a car at a terminal station in four seconds; and ordinary stops at intermediate stations, where many passengers leave and enter the train, are made in six to eight seconds. Since the introduction of these cars, the number of accidents to passengers, always comparatively few and trivial, has decreased.

What are known as "tank locomotives," or locomotives carrying a supply of fuel and water upon their own frames, instead of upon separate tenders, are used almost exclusively for this service, and it is the most extensive use of this class of locomotives in the country. These locomotives are approved for suburban service

on account of being more compact, and cheaper to operate and maintain. They run without being turned, and are safe when the engine is running with the tank ahead. Express trains are run between Van Buren Street and Hyde Park, a distance of about six miles, without a stop.

The suburban service of the Illinois Central includes a number of special features, such as regular fast through special trains, making long distances without stops, for the benefit of business men; also special and regular trains for golf-players and picnic parties, as well as for the accommodation of all classes of people. The service is not entirely confined to the carrying of passengers, special cars being fitted up for the expeditious handling of mail and express.

It would take us too far afield to enter into a similarly detailed discussion of other features of the service; e. g., how station and train platforms are on the same level; how train platforms are railed, and closed in with gates, to minimize the risk of accident; how electric bells at station waiting-rooms announce the approach of trains; etc., etc. After all, suburban, like any other kind of railroad service, to be the best must be properly managed, and this is the secret of the Illinois Central Company's success from the World's Fair period to the present moment.

THE INDUSTRIAL COMMISSIONER

WILLIAM H. MANSS, INDUSTRIAL COMMISSIONER, CHICAGO, BURLINGTON & QUINCY RAILROAD

The pre-eminent factor in all business of modern times is the tendency toward concentration, and in this, as in all things, it is the direction in which we are moving that determines the final destination. We may not agree as to the contributing causes, but we must recognize the fact that both in the United States and in Europe, where different conditions prevail, the highest efficiency of production at the minimum expenditure of labor and capital is the result of concentration. This concentration means centralization of power, and centralization of power means specialization. Specialists of the highest capacity must be secured for the management of the various departments.

The railroads are representative of this concentration in business, as each department is managed by a trained specialist. As President Hadley, of Yale, has said: "Among all our important industries the railway is the one which has most quickly and completely felt the effects of modern methods in the handling of capital." The Freight Traffic Manager knows more about freight rates, freight-handling, freight classification, than any man of the railroad. Under him are the tariff clerks, the classification men, the solicitors, etc., with their specialties; all, however, in the last analysis subject to the Traffic Manager. This is true

of every department of the railway service. No official presumes to interfere with the management of any department not directly under his supervision; for such interference would be a gross violation of the unwritten law of railroad etiquette. That this is the day of the specialist is more marked in the railway service than in any other branch of modern industrial life. I have gone into this concentration and specialization in railroading at some length in order to show why the creation of new traffic and the development of territory contiguous to the railroad have been assigned to one department—the Industrial Department.

The creation of new traffic is not a modern development of railroads. American roads from their inception were built to create new traffic. Herein lies one difference between American and European railroads. Europe, with her centuries of development and dense population, built her railways to accommodate existing traffic, both freight and passenger. The builders knew approximately how much traffic they could figure on, before a mile of road was laid. In America the situation was that of a sparsely settled country; the larger part of the territory through which the contemplated roads were to run was yet in the possession of the government, waiting for settlers. The roads were built for the purpose of creating traffic, of settling with immigrants and pioneers the vast prairies, of building towns and enlarging the scope of their mercantile activities, and, with the increase of population and wealth, of establishing factories and converting the raw materials into finished products. So, I repeat, it is not a

new movement on the part of the railroads to create new traffic. The assigning of this work to a new and separate department is the result of concentration, and of the recognition of the fact that the creation of new traffic is a business in itself, demanding a specialist to study, plan, and execute as in every other department.

Why the Industrial Department is a development of the closing years of the nineteenth century, rather than dating back to the beginning of the railways and their organization into departments, becomes apparent when we stop to consider some of the economic changes of the United States. We are called an agricultural nation. It took from the time of Washington's eighth annual message to Congress in 1796 to the days of the Civil War to pass a bill establishing the Department of Agriculture. It required twenty-six years more before its secretary was recognized as a member of the President's cabinet. When the lands of the East became exhausted, the West still had large areas open for the homesteader. These lands were at the disposal of the government, and were all in the rain-belt. About the year 1890 a marked change was noticed. Since that date all free lands at the disposal of the government are found in the arid—or, strictly speaking, the semi-arid—regions, where the average rainfall is only from twelve to sixteen inches per annum. Cut off from migrating to the free lands in the rain-belt of the West, the eastern farmer commenced to pay more attention to scientific farming. The attention of Congress was called to the great possibilities of irrigation, and the Department of Agriculture looked to similar regions of Asia and

Europe for seeds and plants to be grown in our semi-arid regions, with the hope of larger results. Irrigation, however, is limited to the water supply of the rivers, and its danger lies in an overproduction of ditches, which will mean discontent and trouble. Semi-arid cereals must find their places in the markets of the world, and machinery must be created for their utilization and education for their adoption.

The passing of the free lands in the rain-belt had, however, a greater effect upon the industrial history of the United States than it had upon the agricultural; for the year 1890 is an epoch-making one in the commercial life of the nation. Before then the farms of Europe contributed the largest number to the population of the United States, and those who follow the reports of the Immigration Bureau will notice that before 1890 the Teutonic, Anglo-Saxon, and Celtic races predominated. Since then, however, the Slavic and Latin races have contributed the largest number of our adopted citizens. They are recruited in large part, not from the farms, but from the congested cities and towns, and from the factories and the mines, of the continent. Before 1890 the faces of the immigrants were turned toward the growing West and the possibilities it contained; but today the city nearest to their port of landing keeps the majority of them. The open air, the battle with nature, the mastery for a home and a farm, were then the short history; today it is the shop and the factory, and the wage-earner—one of a procession of flat- or tenement-renters.

This is true, not only of the immigrant, but of the

American-born citizen. In the growth of families, the farm became too small to support the second generation. An outlet had to be found. If farming were to be the vocation, some must leave the home to go where free or cheap lands were still available. Canada thus attracted many. It is stated that over fifty thousand American citizens emigrated to Canada in 1904, to become members of another nation. The population of some states—as, for instance, Iowa—is reported to have decreased from 1900 to 1905. The farms could not provide a living for this generation, and they must seek other fields of activity. To what could they turn but to the industries? In 1880, 44 per cent. of the total population of the United States were engaged in agricultural puruits, and only 32 per cent. in commercial and industrial life; whereas in 1900 only 35 per cent. followed agriculture, and over 40 per cent. the industries and commerce. The growth of our cities is also indicative of the change toward industry. Since 1890 over 37 per cent. of our people live in towns of four thousand or more, whereas before that not more than 22 per cent. were found in towns.

In 1900 we had 44 per cent. more factories, 50 per cent. more capital invested in manufacturing, 25 per cent. more laborers in those factories, and the annual value of the output was worth 40 per cent. more than before 1880. In 1860, 81 per cent. of our exports consisted of agricultural products, but in 1900 they amounted to only 60 per cent. During the same period our manufactured products increased from 12 to 32 per cent. of our total exports; and this increase has

risen to larger proportions since 1900, some estimating it as high as 45 per cent. As an exporting people we rank third. Summing up, our manufactured exports have increased 483 per cent., whereas our exports of agricultural products are but 71 per cent. of what they were before the war. It might also be interesting to note the increased amount of coal, iron, cotton, etc., that we are using, as compared with the five great nations of Europe, but the time at our disposal will not allow this.

It is evident, then, that the Industrial Department is the result of the natural development and economic changes of our nation. How best to meet these conditions, and to present the advantages which the railroads had to offer to manufacturers in the way of raw materials, fuel, labor, and market, was the problem that the managements of the roads had to solve. With the press of their own duties, the heads of other departments could not devote the necessary time to make a careful industrial study of the territory through which the road ran, to devise ways and means for interesting manufacturers or local capital, nor to establish industries and develop raw materials. What is everybody's business is nobody's business, and the many activities needed for the creation of conditions conducive to industrial development demanded a specialist. Such a specialist, called the "Industrial Commissioner," is to-day an official of many railroads.

What are the essential requirements of an Industrial Commissioner? Concerning this there may be a difference of opinion, as every road has its own peculiar

problems demanding a man of temperament and training able to deal with those conditions.

The Industrial Commissioner must be a student of human nature—a man accustomed to deal with people. His office is much frequented by persons seeking information, asking advice, or presenting propositions. He can save much time, expense, worry, and misunderstanding if he can read character. There are promotions, and schemes of promotions, between which the Commissioner is called upon to differentiate. "To err is human," but corporations are looking for results, and one can be busy about trivial things and neglectful of the larger.

The Industrial Commissioner should be a student of political economy. Thus he is able to note the changes taking place, and, with a resourcefulness common to all developers, to adapt methods to the changed conditions. He should have what we might call a speaking acquaintance with all manner of business. A manufacturer seeking a location is favorably impressed when he learns that you know, if only in a casual way, something about how he does things. Thus you are enabled to speak more intelligently on the sources of the raw material, the fuel supply and its amount, the market for the finished product, and the class of labor employed. With such information a bond of sympathy between yourself and the person seeking a location is established, and this confidence will be of great assistance in the competition for the locating of the plant.

The Commissioner should know the relative amounts of certain commodities produced, and the total imports

and exports. This is of great value in soliciting capital for opening mines, developing raw materials, establishing new factories, or in preventing some of the communities along the road from making investments which, in the very nature of things, would mean failure or long discouraging years of adversity. Advice from railroads, I appreciate, is gratuitous, but many Industrial Commissioners have received the gratitude of communities, not only for locating an industry, but for dissuading them from locating certain others. There is such a thing as having too many factories of one kind, and their establishment means that the "For Rent" sign sooner or later will be nailed to the front door. These vacant factory buildings are a menace to the establishment of other industries. In agricultural sections, where money heretofore has largely been invested in farms and farm mortgages, one industrial failure becomes the slogan of the so-called conservative element of the community. A tombstone makes a marked impression.

In seeming antithesis to the foregoing, I would name the attribute of optimism as essential to a successful Industrial Commissioner. I do not mean by optimism either an oriental imagination or the quality of seeing everything as blue sky; for our economic life depends ultimately upon our relations with material things. The dreamer is essential to life's progress; but an Industrial Commissioner is one who has been on the mountain-top and beheld the possibilities, and then has entered the valley of work to realize his vision. We may call it optimism in service, which calls forth all reserve

patience, tenacity of purpose, untiring effort, and faith in the ultimate outcome.

To the peculiar traits which each man possesses, prophetic as they are of his success or failure, must be added the spirit of co-operation. There is no department of the railroad where co-operation is more demanded than in the Industrial Department. It depends more or less upon every branch of the service, and requires the assistance of many an employee. This may seem a strong statement; therefore let me illustrate. A manufacturer is contemplating a location. To locate him to mutual advantage, the Industrial Commissioner must consult the Freight and Passenger Departments on the question of rates; in case of sidetracks, the Operating and Engineering Departments must be conferred with; should there be a lease of company land involved, the Real Estate and Tax Agent must give his recommendation; the question of contracts must be decided by the Law Department; the Auditing, Claim, and Advertising Departments likewise are involved; and at all times the executive officers are consulted relative to plans and methods. The success of an Industrial Commissioner is largely due to the active co-operation and assistance he receives from every department and employee of the road.

As the superintendent of a factory familiarizes himself with his plant, its machinery, and his men, so must an Industrial Commissioner acquaint himself with the territory through which his road runs. If he can know it for thirty miles on both sides of the rails, so much the wiser is he. He ought to spend the first six months

of his time on the road, putting himself in close touch with the factories, their owners and managers, and the business men of the towns; studying the conditions to learn where the raw material is found, and the prejudices for and against certain kinds of industries. This knowing and becoming known is of much assistance in the correspondence which will follow. It is more satisfactory to correspond with a man you have met than with an utter stranger. You are thus able to cultivate a spirit of co-operation, and to send seekers of locations where they will meet a hearty and attentive reception. Prospective manufacturers have been lost to roads because they were sent to towns which were prejudiced against their kind of manufacturing, and because they, reasoning from the particular to the general, concluded that the railroad was opposed to locating an industry like theirs on the line. While becoming personally acquainted with the various officers and agents of the road, the towns and their representative citizens, a complete census of every town. village, and hamlet along the system should be made.

The population of a town and of its surrounding territory naturally is important to every prospective manufacturer, as on that depends the supply of labor. Nationality also is important. There are racial characteristics in trades as in politics and religion. Certain nationalities are more skilled in some lines of manufacturing than in others, and some manufacturers prefer and require certain nationalities because of their past experience. The assessed value of the town and the tax-rate are closely scrutinized. The death-rate indi-

cates the healthfulness of the place. Every merchant and manufacturer needs the services of the banks, and he wants to know their number, amount of deposits, total capitalization, and the provisions for savings banks or loan associations for his employees. If hard times come, the so-called country bank takes a personal interest in a local corporation, and is more willing to provide funds than the large city institution.

Some towns have suffered from a want of manufacturing activity because of the unfitness of the water supply for boiler purposes. In some towns factories cannot be induced to locate because the citizens, fearing an increased tax-rate, have voted against a water system, and thus are not able to provide fire protection.

A complete list of every industry on the system is essential to the Industrial Commissioner, that he may know the kinds of industry, the number of hands employed, and approximately the amount of business done in each town. By ascertaining this, manufacturers can determine, before seriously considering a city, whether they can, with advantage, locate there, and whether their line of manufacturing will conflict with, complement, or co-ordinate with the existing industries. For instance, from these reports a foundry seeking a location could obtain information as to the number of factories using castings, the kind and amount, and whether a local market for its products existed.

The subject of climatic conditions, as they affect labor, is an interesting one, on which I shall not, however, enter here. Suffice it to say that in the rigor of

the arctic regions, because of the benumbing temperature, long nights and short days, scant supply of food and fuel, great economic strides cannot be made. In the tropics, with the profligacy of nature and enervating heat, activity is not looked for. The temperate zone is the home of the greatest economic progress. The changing seasons and the environment have much to do with the success of labor.

Another important item is the labor and cost of labor. This, and the question of fuel, raw materials, and market for the commodity, are the four chief considerations. Many factories move in order to change their labor problem. Hence it is important to know what percentage of the people own their homes, and the politics of the town—not the partisan politics, but whether the predominating political power is in the hands of the men who own their homes, or in those of the renters; whether equity and justice prevail, and protection is afforded. The class of labor, the market for securing labor, the intelligence of the community, the educational and religious advantages for the family, and the character of labor utilized, male or female, must be known. Where the father and brother find employment, and the girl cannot, the family is likely to move to a place where all members desiring work can be accommodated. Often factories are in demand which employ none but women, in order to give employment to girls already there and to induce other families to move to the town, thus increasing the supply of male help. The price of labor will adjust itself to the supply, demand, and skill required.

Without the raw material there can be no finished product. There must be hides for shoes and harness, timber for furniture and paper, iron for rails, etc. The office of the Industrial Commissioner should be a miniature museum, containing samples of the various clays, sands, gravels, coal, and other minerals, from the entire system—each with an analysis attached whenever possible—together with a list of the places where timber, hides, wool, etc., may be obtained in abundance.

The Mississippi Valley, with which I am most familiar from the standpoint of manufacturing, is not at the present time blessed with water-power good for twelve months in the year; and water-power needing an auxiliary steam plant is not considered remunerative from an investment point of view. The power of the larger plants is thus derived from coal. Where this coal is found, the cost at the mines, railroad rates, heat units, disintegration, and the ability of the mines to supply the demand is necessary information. With the United States owning 40 per cent. of the coal area and producing 33 8-10 per cent. of the coal of the world, our economic growth can be said to be due in large part to the value, accessibility, and nearness of our coal-mines. The other mineral resources need capital for their development and exploitation. Often manufacturers are ignorant as to where their raw material can be found, and one of the functions of an Industrial Commissioner is to present to the business world facts relative to the location of the raw material; with the result that capital is soon raised for its

development, and an increased traffic in a new commodity gained for the road.

Most manufacturers and jobbers of today have distant markets for the product which is moving away from their plants; and, in order to be near their markets, they either must move or provide warehouse facilities near their source of demand. Business of today is conducted differently from what it was fifteen years ago. Then it was no uncommon thing for a merchant to purchase his supplies for an entire season. Today the retail merchant allows the manufacturer or jobber to carry the stock, while he orders in small amounts, and demands that his order be filled and delivered at his store within forty-eight hours after ordering. This has led to the building of large warehouses throughout the United States, so that these short-time orders may be supplied and the manufacturer have a place for storage facilities. The warehouse proposition is one of the new phases of the Industrial Department. When the manufacturer cannot be induced to move his plant, advantages may be shown for the building of a large warehouse along the tracks of a railroad. Thus freight is created, and such a warehouse becomes a permanent source of traffic, both in and out.

The Industrial Commissioner, together with the land and immigration agent, makes a market for the various commodities by increasing the population of the country. Farming has been extensive rather than intensive, and many are the unutilized waste places. The virgin soil and favorable climate in the past have

produced in abundance, and large returns were obtained from low-priced lands. But lands, like corporate interests, have increased in value, and farms once purchased for ten dollars per acre have increased to one hundred dollars per acre or more. Watered stock you might call this, looking at it from a certain point of view. But the revenue on this valuation does not pay the fixed charges, and the farmer must apply the scientific method of farming, select and test his seeds, etc., and thus earn, not only the fixed charges, but also a dividend. The instruction of the farmer by means of the so-called "seed and soil" trains is a part of the work of the Industrial Commissioner; for he thus develops his territory, increases its productivity and wealth, betters its environments, creates more traffic, and ultimately will make farming more intensive rather than extensive. Intensive farming means more farms and larger population to the square mile; and with an increased population the factories must soon come.

Organization for action is generally accomplished by establishing commercial clubs, or improvement associations, where such associations are not found; or by reinfusing into established associations, which have degenerated into social clubs, the spirit of their charter. This is one of the difficult tasks of the Commissioner. The enmity and jealousy in small towns are proverbial. The fear that some one member of the club will benefit by the coming of a factory has kept many a town from realizing its possibilities. Around the stove in the country store sits the power that has prevented many a geographically well located town from becoming a

large industrial center. To such towns one must go and tarry, showing with all the force and power at one's command that, as mercantile centers, they are in a state of decadence; that the circle of their agricultural trade is yearly growing smaller because of the new progressive towns which have been founded near them, because of the inroads made by outside merchants which deprive them of much of their business, and because the rural mail delivery has made it unnecessary for the farmer to go to town for mail or to purchase his supplies from the local merchant; so that their continued prosperity depends upon their adding an industrial business to their agricultural and town trade. The employees of shops trade with the local merchant and rarely spend their money in other towns. Then, after organizing their commercial clubs, it must be learned what class of industries they desire, and how they wish to foster and induce them to come; or their attention may be called to certain small local industries which, with more capital, could be converted into larger institutions; or, perhaps, to some raw material in their town or vicinity which could be converted into the finished product at a profit. An active association can often thus be established, and a manufacturer sent there will always find someone to greet him, to show him the advantages of the town, and to call on short notice a committee to discuss with him the proposition, and he will thus receive encouragement for locating his plant. Enthusiasm for local improvement is a unifier of interests, and a destroyer of personal enmity and jealousy.

Press clippings, trade and mechanical journals, the

many railroad agents and traveling salesmen, and personal contact with manufacturers and promoters of the better type, will greatly assist in obtaining information of manufacturers seeking new locations, or of those desiring to develop certain kinds of raw material. No fixed rule can be framed for handling the various locating propositions presented. Each demands a careful analysis and a treatment peculiar to itself. Some demand a bonus; others, an increase of stock; others, a site; and in others the raising of the entire amount of capital is necessary. Some of the firms advertised as seeking new locations should be sent to a financial hospital rather than to towns for the recuperation of their capital. Patentees who have devoted time, money, and energy to the perfecting of an invention do not always realize that a patent right does not carry with it a guarantee of commercial and financial value. Investigation, opinions of experts, and discernment on the part of the Industrial Commissioner are necessary before he dare call the attention of a commercial club to a company whose capital stock consists of these untried patents. Although commercial clubs judge each firm on its merits, yet they consider the unqualified introduction of a manufacturer or promoter by an Industrial Commissioner as equivalent to an indorsement by the railway company, and for that reason will often grant a hearing and extend courtesies. Any industry desiring concessions or financial inducements for locating ought to give to a responsible committee of a town a report such as it would give, should it go to a bank and ask for a loan. Those who refuse to do this ought

to receive no consideration. When firms locate without asking for financial assistance from a community, their books are closed to the public; but when a firm does ask for financial help, it becomes, for the time being at least, a quasi-public institution.

I might speak of the work of a Commissioner in suggesting improvements in terminal facilities in the larger cities, which will necessarily bring more jobbing-houses, warehouses, and factories; of his suggestions for better facilities to take care of the traffic of the established industries; of his work in negotiating for side-tracks, as well as of his duties in representing his road at the banquets held by the various commercial clubs; but time will not permit, and I shall close with the following observation:

It is not only in the establishment of industries, in the development of the territory to its highest productivity, or in the increase of its population, and of so-called secondary or local merchandise freight, that the Industrial Commissioner can be of value to the railroad; but he also impresses upon its constituents that their interests are identical with those of the road, which is anxious to assist in building up their towns, by doing all that can reasonably be expected of it. For by increasing the prosperity of the farmer, the merchant, and the manufacturer, revenue is added to the railway's treasury. Thus the Industrial Commissioner secures for his road the good-will of the people; and, in the final analysis, since prejudice for or against is one of the strongest human incentives, the good-will of the people becomes one of its most valued assets.

This good-will obtains many carloads of freight, assists in securing passenger traffic, and makes possible the granting of the requests of the railway company. The Industrial Commissioner should be the link of harmony and co-operation between the public and its greatest benefactor.

THE PROBLEM OF HANDLING LESS-THAN-CARLOAD FREIGHT EXPEDITIOUSLY AND ECONOMICALLY AT TERMINAL STATIONS

NELSON W. PIERCE, LOCAL FREIGHT AGENT, CHICAGO; CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

The problem of handling less-than-carload freight expeditiously and economically at terminal stations is one that has in the past commanded, and will no doubt in the future continue to command, the most careful and studious attention on the part of railway officials having direct charge of terminal work at large originating and distributing points. While it is a very broad subject, capable of elaboration, I do not think it advisable, for the purpose of this paper, to enter into details, but shall confine myself to brief reference to the main features.

As a rule, the volume of traffic has increased much faster than the railway terminal facilities—this will apply as fully to the terminal yards as to the warehouses—and it has been absolutely impossible for the railway managements to anticipate the increasing demands. In the congested centers it has become almost impossible to secure additional ground room. Another feature, especially characterizing Chicago deliveries, is the irregular manner in which the freight is delivered for shipment. As a rule, the deliveries during the morning hours approximate 40 per cent. of the total tonnage of

the day. The heavy deliveries are made later in the day, and this fact very seriously handicaps the expediting of terminal work, from the point of view both of economy and of safety. The question of labor also enters into the matter of handling less-than-carload freight with due regard to economy of service. It is almost impossible to maintain a force sufficient to meet the emergencies, and it is, in many cases, equally impossible to fill in the depleted ranks promptly. Hence, with the extremely exacting conditions insisted upon by the business public, it is an absolute impossibility to supply all demands, either in receiving freight or in delivering it to the public.

If freight delivered to the railway companies for forwarding to the consuming territory could be delivered with uniformity as to hours during the day, it would greatly tend to avoid delays at terminals and in forwarding, reduce to a minimum errors in loading and billing, and greatly improve conditions contingent upon the handling at the forwarding terminal. Special efforts have been made in the direction of overcoming the difficulties cited above, but commercial conditions have rendered it impossible even partially to relieve the situation.

The local freight agents in Chicago and at other points have in the past investigated the problem in its various phases, but, on account of the location and terminal facilities, it has been found extremely difficult to formulate a system that would apply to all. My recommendation in regard to this much-vexed question is that a system of uniformity should be adopted by the

various lines, based on practical experience in regard to—

1. The hour for delivering at freight stations.

2. The method of receiving, inspecting, and loading freight cars.

3. Uniform hours for closing warehouses, to prevent delays in forwarding trains, at the same time enabling the billing force to prepare the waybills in time to avoid delays in forwarding.

4. Concerted action by terminal lines, which will, in my opinion, result in closer understanding with the shipping public and, to a certain extent, secure their co-operation in correcting the difficulties of the past and present.

With a uniform system and a mutual understanding, as suggested above, the honest co-operation of the shipping public, and reasonable consideration of the terminal necessities by the railway managements in furnishing the best facilities consistent with the existing conditions, the problem resolves itself into a question of using the terminal facilities to the best possible advantage; and, as the future depends on the Local Agent, he will, as a matter of pride and precaution, use his best efforts to handle the business promptly and economically. This is a matter of practical experience, as theories applied to the ever-changing conditions cannot work out good results.

The teaming community has been more or less responsible for the unfortunate conditions at terminal stations in the past, caused, to a great extent, by labor troubles involving the different branches of labor

unions. These conditions are, however, improving, and it is sincerely hoped that the disturbing element will soon revert to normal conditions.

To handle this business expeditiously and economically, it is necessary to have sufficient warehouses and team driveways to accommodate it; also, cars for loading the same, proper distribution of territory to be loaded in each car, the least possible handling of freight from the time it reaches the freight-house door until it is deposited in the proper car for forwarding, and the least possible changes in the loading of cars both as to stations loading in them and places situated on warehouse tracks for loading.

The question of handling freight economically must be looked at from two different points of view, the operating and traffic. While it is a simple matter, from an operating standpoint, to reduce the cost from one to two cents per ton by reducing the force, this, as a rule, means more detention to teams, which immediately gets the Traffic Department into trouble; with the result that, if sufficient help is not put on again and at once, the shippers threaten to withdraw their business and ship via other routes. Ofttimes the business lost in this way is difficult to estimate and hard to regain, the company losing more in the reduction of freight traffic than it gained in the diminution of the cost per ton. Therefore, from a business standpoint, it is not always a question of how cheaply a freight-house may be run, but how well; always keeping an eye on the expense, making every dollar count, while, at the same time, giving the shipping public the best possible service,

with the least possible detention to teams. Such a policy is bound to bring the business your way, as against your competitor who has reduced his cost per ton to a point where he cannot take care of his business promptly and satisfactorily.

Another problem that has given the officials of railroads a great deal of serious thought is the proper loading of freight so as to prevent overs and shorts. In the old days the chalk system was used; in fact, it is still in use on some roads. According to that system, when the freight was received, the caller called off the consignee and destination, the receiving clerk called back to him the car number and location, which were put on the box with chalk, and from these marks the trucker delivered the freight to the car. This method had, however, so many drawbacks that it was discarded by the Chicago, Milwaukee & St. Paul Railway and replaced with the veri-check system.

The introduction of this system has had a noticeable tendency to reduce the overs and shorts, as the inspectors daily detect more or less freight, dropped into wrong cars by the truckers without being detected by the stevedores, which would have gone astray under the old system. It is true that the cost is increased under the veri-check system, as it costs from one to two cents per ton more to operate than under the old chalk system; but this additional cost is made up in the claim department by paying less claims on account of freight being incorrectly loaded. Besides, it produces a better feeling with the shipping public to know that

every safeguard is being put around the loading and forwarding of freight.

The most important factor in the loading of less-than-carload freight is a good staff of freight-house foremen, who understand their business thoroughly; who are capable of reducing the number of errors to a minimum, and to trace and rectify those that have occurred; who are competent to investigate and locate complaints, to arrange for their correction, and, to guard against their recurrence; and who are sufficiently good judges of human nature to select, from among the applicants for freight-house work, the highest standard of men for truckers and callers, as it is from the ranks of these that the positions of receiving clerks are filled. The assistants in each house should watch the receiving clerks, callers, and stowers, taking care that they do their business properly and with dispatch, and that the truckers do not loiter and kill time in the runs. All freight-house team-yards should have a man to look after the teams arriving and departing, whose duty it should be to advise and instruct teamsters which doors to pull into to avoid delays, and to keep the freight-house doors busy, distributing the work at the doors equally.

On the work of receiving clerks and callers largely depends the prompt and proper handling of less-than-carload freight, outbound, and it is of the greatest importance that these two branches of the work should be filled with the best class of men that can be hired for the money. Their work is of the most trying kind, especially the callers, who are the men that come in

direct contact with the teamsters and are obliged to read the marks on the packages. There are a great many indifferent and incompetent teamsters, who do not properly stow their shipments on the wagons, thus causing long delays at the receiving doors, due to the fact that the freight must be sorted out before being loaded on trucks, and weighed and called off to the receiving clerk.

Another impediment to the rapid handling of business is the indifferent manner in which some of the firms mark their freight. They seem to labor under the impression that the rule, adopted by the railroad companies a few years ago, that each and every package must be plainly marked as to consignee and destination was issued expressly for the convenience of the railroad companies, and they mark their freight in any way, so long as there is a partial compliance with the rules sufficient to avoid the danger of having the freight refused and returned to them. If the shippers would co-operate more closely with the railroad companies in marking their freight with a brush and ink, instead of with a carbon pencil, which shows up poorly on everything, and especially on certain kinds of boxes, it would materially reduce the expense of the roads as well as of the shippers, since the teams would be released that much sooner, loss would be prevented, overs and shorts would be decreased.

The hours for delivery of less-than-carload shipments to the out-freight houses should be from 7 A. M. until 5 P. M., it being important to close these houses earlier than is the custom now, in order to allow the un-

loading of all teams earlier and the loading-up of all freight received. This would enable the pulls from the houses to go to the distributing yards promptly at 6 o'clock, to be made up into trains, which could leave without delay, and thus arrive at their destination at the earliest possible moment. If the yards are kept open later than 5 P. M. for the receiving of teams, either the pulls from the houses, and consequently the departure of the trains, are delayed, or the freight is allowed to be piled up on the freight-house floor, causing the additional expense of rehandling, as well as risks of loss and damage by fire or otherwise by carrying freight in the warehouse over night. I do not think there is a railroad in the city of Chicago that does not carry over more or less merchandise freight, except Saturdays and Sundays, on account of late delivery. This could be avoided by earlier closing, and with concerted action on the part of all roads, and still the same business be done. The shippers in that case could not attach all blame for delay to the railroad companies, as they do now.

In this connection, there is a very important matter which must not be overlooked, viz., the billing of the freight, and the proper sorting and assembling of the bills to be sent to the distributing yards or passenger depots in time to go forward with the regular freight trains or by train mail, and reach their destination promptly. The fact that, at the present time, 60 per cent. of the freight for forwarding at the freight-house is received after 2 P. M. involves considerable work in the office after 6 P. M., and many opportunities for errors and delays. Arrangements should be made with

shippers to send their shipments to the freight-houses more uniformily at all hours of the day, instead of concentrating them in the afternoon, and to load their wagons in such a way that each and every shipment, whether consisting of one, twenty, or more articles, can be unloaded from the wagons to the warehouse trucks without any delay in sorting out the articles after arrival at the depot, each article being plainly marked wih the full name and destination, and the accompanying shipping ticket showing its actual weight. Such arrangement would materially facilitate the handling of less-than-carload freight. The railroad company furnishes a receiving clerk to check and receipt for the goods; a caller to take the goods from the wagon, place them on trucks to be weighed, and forward them to the car; and a stower to receive and properly stow them in the car; but a majority of the shippers, as a general proposition, send their goods to the freight-houses so loaded on the wagons that it is impossible to sort out the different packages for any one shipment, thus compelling the railroad companies to unload nearly the whole load on the freight-house floor in order to sort out the different shipments. This is a source of great annoyance, delay, and additional expense to the railroad companies, as well as to the shippers themselves on account of their teams being delayed. Again, much of the teamster element of today is of such an indifferent and incompetent character that it is difficult to make any headway at the receiving-doors, more delays arising from this, as a general thing, than from all other transactions in the houses.

As an illustration of how the business is handled at the Chicago, Milwaukee & St. Paul Railway Company's out-freight houses in this city, I will say that, for the out freight, less-than-carload shipments, we have two warehouses, the length of two blocks. There are twenty-nine receiving-doors on the team side of the houses, and nineteen doors on the car side, at which are placed at one time, for loading, 152 cars, nineteen cars in length and eight cars in depth. Each car is designated by a name and number, and is so placed each and every day of the week. The tracks are all numbered, beginning at the house, from 1 to 8, and the runs through the cars are numbered from 1 to 19, beginning at the west end of the house.

To illustrate the manner of a shipment received for any one of these 152 cars, suppose that a team backs up to Door 19, with a shipment for Deerfield, Ill.—a station on the Chicago & Milwaukee Division, between Chicago and Milwaukee. The caller will take the shipment from the teamster, put it on a warehouse truck, run it to the scale, and call off the name of the consignee, city or town, state, and weight. The receiving clerk will check the shipping-ticket to see if the same is correct, and, if so, will give the caller a veri-check ticket, bearing the box number, run number, number of pieces of freight, with his signature attached. This ticket is placed on a piece of freight on the truck, which is thereupon pushed out to the center of the house for the first trucker coming along to pick it up and take it to the car in which it belongs; or, if a trucker is present, it is handed directly to him. The trucker is governed, as

to the movement of the truck, by the box and run numbers on the ticket. The particular car in which this shipment loads would be the Pennock car, which takes freight from all stations on the Chicago & Milwaukee Division, from Pennock to Everett, of which Deerfield is one; and the run number would be 17, since the car stands 17 on Track 1. In each car there is a box numbered to correspond with its location on the track. The trucker will go to the car and see if the number on his ticket corresponds with the number on the box. If so, he will have the stower receive the freight and deposit his ticket in the box, taking his truck back to the house, and leaving it wherever he finds the first loaded truck, which he immediately handles in a similar manner. The stower will examine the shipment to see if it is in good condition, and will then stow it in as near station order as possible, putting the last shipments to be unloaded in the end of the car, the loaded near the door.

Of in-freight, less-than-carload freight-houses we likewise have two, and we set for unloading at one time, at House 1, thirty-three cars; at House 8, twenty-three cars; total, fifty-six cars. We work the men in gangs of four or five, as best suits the business, the gangs consisting of a check clerk, a caller, and two or three truckers. The houses are divided into sections, both lengthwise and crosswise—crosswise as to the number of doors on the side of the house, and lengthwise with a fence through the center of the house, between the different sections as made by the doors, the north side of the house in each section being used for the placing of transfer-to-connecting-line freight, and the south side

for city freight. The check clerk takes his gang and goes to the first car adjacent to Door 1; the caller picks up the freight, puts it on a truck, calls off all the marks on the packages, which the check clerk then enters in a blind tally-book provided for that purpose. If it is a shipment for tranfer to a connecting line, the trucker will be instructed to put it in Transfer Section 1, which will be the north side of the house; if for city delivery, in the city section, which is the south side of the house.

To show how the men delivering or picking up freight for a connecting line know where to find it, let us suppose a man takes the numbers and initials of all the cars set at the house for unloading, and enters them in a book provided for that purpose in the foreman's office, showing opposite each particular car its section for unloading. The expense bills for connecting lines, when sent to the foreman's office, are numbered to correspond with the section in which the car is unloaded; and all expense bills for city freight, when taken from the cashier's office by owners or others, are presented at a window in the foreman's office, where there is a man whose business it is to section-number them, putting the number of the section on the expense bill. The party after the freight then takes it to the delivery man of that section as numbered, who gets the freight and delivers it to the owner, taking his receipt for the same. In the case of such freight as butter, eggs, or cheese for connecting lines, it is sent directly from the cars to teams for transfer.

The in-freight, less-than-carload business requires good men for callers, checkers, and delivery men; and

I am sorry to say that they are hard to get and to keep. Before the days of the union we could and did get the proper amount of good work out of them, but at present it is different, it being their policy to do as little as possible for their pay, and not to allow a good worker or a non-union man to remain among them.

As a matter of information, I may say that the less-than-carload business at the out-freight houses of Chicago averages some 800 tons per day, loaded into some 175 cars, being received from some 700 teams, the time spent in unloading the teams averaging about 20 minutes. At the in-freight houses there is unloaded a minimum of 100 cars each day, with a minimum tonnage of 400 tons, and, besides all of the deliveries to city teams, there is a minimum of 100 teams per day loaded with freight for connecting lines. The business is increasing in volume every month, and, under the conditions, we are justified in expecting at least a 10 per cent. growth each year.

OFFICE WORK IN TERMINAL YARDS

FERDINAND S. ATKIN, SUPERINTENDENT OF TERMINALS, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

The office work connected with yard operations may be divided into three distinct parts: (1) "receiving," or "in-freight;" (2) "forwarding," or "out-freight;" and (3) "transfer," or receiving from and delivering to connecting lines. In immediate charge of this work is a chief clerk, who must be a man of considerable executive and business ability, since he is virtually the acting superintendent many times in a day.

1. *In-freight.*—The clerical routine arising from the receiving of freight arriving in trains from off the company's lines demands, for its handling, a force consisting of a "train clerk," "number-takers," "seal-takers," "carders," a "transfer clerk," a "grain-sealer," a "rate clerk," and an "expense-bill clerk;" besides, of course, the chief clerk.

On the arrival of a train in the yard, the number-takers secure a list of the numbers and initials of all cars in the train, also noting the condition of loads on open cars—whether they are low enough to clear tunnels, bridges, etc., and whether staked on the cars, etc. All the doors—side, end, and roof—are inspected by a seal-taker, who records the seals attached to them. The seals now generally employed are made of tin, with a circular piece of lead attached. The tin band bears a serial number, and the lead disk, after a car-door has

been sealed, bears the impression of the seal-punch used—either letters or numbers identifying the station where the punch is used. All of these seal numbers or letters must be taken, and a copy made in an impression-book for future reference.

In the meantime the train clerk examines the waybills as carefully as possible for "hold" or "diversion" orders, and makes a transcript of them on the "train-sheet," stating the car number, initial, forwarding station, destination, contents, and via what connecting line. After the train clerk has completed the transcript, a carder tacks on each car a card showing the road to which the car is to be transferred, or, should it be destined for the home road, the switching district to which it is to be taken. The train is then ready to be switched into the classification-yard.

Some of the incoming cars may have to be transferred to other railroads, and a record of all such is kept by a transfer clerk, the expense-bill clerk making out an expense bill for every loaded car thus handled. In connection with this work, the latter clerk also sees that the bills are properly extended, and it is the usual practice for him to call back the expense bills to the clerk so as to check any possible error.

There is a rate clerk who revises rates, or rather checks them over to see that the freight has been billed at a proper classification, and also to make sure, in case of through-bills, that his company is given its proper proportion of the through-rate. He is held responsible for all errors in wrong rates or extensions made by the billing agent.

Where cars contain grain for inspection, a grain-sealer accompanies the grain inspector, his duty being to reseal all cars opened for inspection or samples.

2. *Out-freight.*—In the "forwarding" or "out-freight" work there are, as in the "in-freight" department, the usual number-takers, seal-takers, carders, rate clerks, and clerks taking care of waybills. As the outbound cars are made up into trains, they are checked as before for their car numbers and initials, and all loaded cars are properly sealed and reported to the train clerk, who then checks up the list of cars and furnishes a waybill for each loaded car, showing the contents, destination, etc. In the case of "foreign" empty cars, a way-, or card-, bill is furnished.

The conductor of the train also takes a list of the numbers of all cars in his train, which list is checked with that of the number-taker, and if they agree, and correspond with the numbers on the waybills, he receives his waybills for the cars. In addition, the list made by the number-taker is given to the car record clerk, who records the numbers of the cars, date of leaving, train number, and destination.

3. *Transfer freight.*—As regards transfer freight—or the receiving of freight from, and the delivery of it to, connecting lines—cars are usually classified for the various roads when first switched, and are then made up into "transfer" trains. A record is made of all cars loaded or empty. Duplicate expense bills are made for each car in the transfer train, showing the name of the consignee, destination, contents, weight, charges, car number, and initial. Both of the bills are

sent to the road receiving the cars, one copy to be signed and returned by the agent of the receiving road, and the other to be retained by the receiving road for its record. Any car received in a damaged condition, or short as to its billed contents, must be noted on the expense bill returned to the delivering road. This is also true as to seals, which, if defective, must be immediately reported to the delivering road by the receiving agent, giving the car number and initial, date of its arrival, and a statement of the trouble. If the expense bill is returned to the delivering road without any such addition, it is an indication that the shipment has been received in good order; and the transaction, so far as the actual transfer is concerned, is closed.

Young men seeking employment with railroad companies dislike to take positions in terminal yards, as the pay is small, the hours long, and the work very exacting. Yet no one expecting at some future time to occupy the position of agent of a terminal station can afford to neglect this work. As agent he would not be able to manage the station so successfully if he did not have the experience to be acquired in the terminal yard. Here is the first round of the ladder, and a person familiar with the small details can handle the general business to better advantage. It is a wide field, and I know of none better suited for a young man making his start in railroading.

CAR DISTRIBUTION AND THE SUPERVISION OF FAST FREIGHT

JOHN M. DALY, CAR ACCOUNTANT, ILLINOIS CENTRAL RAILROAD

CAR DISTRIBUTION

The conditions surrounding car distribution are dependent upon the commodities and the geographical location of the railroad. For instance, it is much more difficult to handle car distribution on a road whose particular product is grain or hay, than on a road where the particular commodity is coal or stock; and, again, it is more difficult to handle distribution on a road with a great number of branches or feeder lines, than on a road that has a straight main line.

The first essential and all-important requisite is that the person in charge of distribution thoroughly familiarize himself with the products originating on his line, and the seasons during which they move. He should also know the destination of such commodities, in order that he may, prior to their movement, gradually accumulate the surplus equipment in the section where it will be needed, and thus avoid hauling the empty cars out of the territory shortly before they will be required for loading. In this manner the empty car mileage, which is one of the large items of operating expenses, is reduced to a minimum.

The Car Distributor must know at all times where his equipment is located. Such information is furnished

him by wire every twenty-four hours, giving the total number of each class of car on hand loaded, empty, held for movement, and in bad order. These data are compiled on each train district by the Chief Dispatcher at a given hour each day, the agent telegraphing the Chief Dispatcher, on a printed form, the number of cars waiting for movement east and the number of cars waiting for movement west, over or less than forty-eight hours; the number of cars held for unloading at his station; the number of empty cars of each class—box, stock, coal, etc.—on hand; the number of cars required for loading, under which item are specified the products awaiting shipment, the destination of the shipment, and, if beyond the home road, the route over which the consignment will be sent, so that the Chief Dispatcher may utilize foreign railroad cars belonging to lines over which the business will move.

In order that the agent may get this information correctly, the shipper is furnished with regular printed forms, on which are shown what cars he requires. This form reads about as follows:

CAR ORDER FORM

________ ________ ________ RAILROAD

____________________, ________________190__

To Agent, ________________________________

____

Please furnish cars as follows:

Date Wanted	Number of Cars Wanted	Kind of Cars Wanted	To Load With	Destination of Shipm't	Route of Shipm't	Remarks

This printed car-order form is supplied to shippers in order to insure getting from them a clear and distinct statement of their requirements, so that the Chief Dispatcher may use his best judgment, and very often furnish a shipper with empty cars belonging to the road to which the traffic will be delivered, that being much preferable to loading the cars of his own line away from home.

For certain commodities, such as lumber, machinery, and ties, shippers frequently order coal- or flat-cars, it being more convenient to load the product into these than into box- or stock-cars. When such orders are placed, showing the commodity, destination, etc., the Chief Dispatcher can, however, often prevail on the shippers to use box- or stock-cars, when it is to the interest of the road to do so. For example, a railroad may have a shipment in southern Illinois for points in Iowa or Minnesota. The shipper calls for coal-cars, which, if loaded into Iowa, where the road has no return traffic for them, must come back empty. On the other hand the road may have some stock- or box-cars moving west empty, which, if utilized, would save the empty haul into Iowa, and, in addition, would save the empty haul from Iowa back to the southern Illinois mines, if the coal- or flat-cars were used. Again, a shipper may order, for instance, Illinois Central large-capacity box-cars for a shipment of grain, cotton, or any other commodity. If he did not insist upon knowing its destination and route, the Dispatcher might furnish Illinois Central cars for it. The shipment is, however, destined for New York or New England points, to which some

eastern foreign cars, then on the division, may be utilized.

This printed form is simply one part of a system which is absolutely necessary to insure successful car distribution. The plainer and simpler the system, the better will be the results obtained; whereas, without system, there can be nothing but confusion. The printing of these small blank costs but a trifle; but by enumerating on them each item of information required, they become a safeguard against agents' accepting incomplete orders and confusing the Dispatchers.

It is a deplorable fact that some employees seem to think that the supervising officials of railroads delight in detecting errors on their subordinates. This, of course, is an entirely erroneous impression: two-thirds of the time of superintendents is devoted to formulating rules and devising means to prevent their men from making mistakes. The superior officer is as much responsible for the errors and acts of those under his authority as he is for his own, and his success depends upon the support given him.

In accordance with the system of car distribution, the shipper must order the cars he requires from the agent at the station where he will load. The agent, at the usual hour each day, will order the cars from his Chief Dispatcher. In case the Chief Dispatcher is unable to furnish all of the cars ordered from his district, he calls upon the Superintendent of Transportation to help him from other divisions or sources. Hence, a shipper cannot order cars direct from the Superintendent of Transportation, or from the Chief Dis-

patcher, without creating confusion. If the Superintendent of Transportation accepted an order of that kind, and directed the Superintendent to take care of it, the latter might order the cars to the station direct; but when they reached there the agent would know nothing about the order. He would ask the Chief Dispatcher what the cars were sent for. The Chief Dispatcher, not knowing about the order, would no doubt instruct the agent to bill them and send them on to some other point where he knew they were required. Had the order been transmitted through the proper channel, when the cars reached the station, the agent would know all the facts connected with it, and there would be no hitch in taking care of the shipment.

The commodities to be moved, and their seasons for shipment, must be carefully watched. The condition of the crops as they mature, and the prospects for marketing them, must likewise be closely studied. On the Illinois Central, for example, we know that fruit and vegetables begin to move in refrigerator-cars from Louisiana points the latter part of March, and keep gradually increasing in volume as the shipping territory expands, until by the middle of June we are loading fruit and vegetables all the way from New Orleans as far north as Centralia, Ill.—a territory of over seven hundred miles. To know what the requirements will be, it is necessary for the Car Distributor to get reports of the condition of the crops as they progress, and of the acreage planted. Frost may kill the tomato or peach crop, in which case he must make his deductions in figuring on the supply of equipment necessary to

take care of it, in order to prevent hauling more refrigerator-cars into that section than are actually required for the business; thereby avoiding the return of empty cars, which involves an enormous unnecessary expense.

There are other factors to consider, in addition to the maturing of the crop. The market price may be extremely low, in which case the grain will not move in such volume as it would if the price were high. The shippers who can afford to store it will naturally do so until the market is favorable. Again, the size of the grain crop is not an indication as to the volume that will move to early market. The crop of the preceding year may have been very poor. In that event a good portion of the present year's crop will be held over for the following year, for feeding and other local consumption, by reason of the supply having been exhausted during the current summer.

The importance of a uniform system in doing work of this kind, which is more or less complicated, and the advantage of a simple method or system, cannot be too strongly emphasized. Let us take the loading of tomatoes, for example. At Crystal Springs, Miss.—a town of 1100 people—we are to load a maximum of forty-five carloads of tomatoes in one day. The refrigerator-cars, after having been iced, are placed on long loading-tracks. The men who receive the tomatoes from the farmers divide the cars before any loading is done, by placing flags in the car doors. A white flag indicates that the teams having green, or unripe, tomatoes are to bring them to that car; a red flag denotes that those having ripe tomatoes are to unload them in

that car; and a half-red and half-white flag means that the medium-ripe tomatoes are to go to that car. In this way the teamsters have no trouble whatever in lining up for the proper car, the tomatoes having been sorted in the fields before being loaded on the wagons. The object of loading them in this manner is to enable the shipper to route the green product to the most distant point, and the ripe product to the nearest market. If a car was loaded with half ripe and half green tomatoes, and shipped to a reasonable distance, the chances are that the ripe tomatoes would age and decay in transit, and long before the green tomatoes were in a marketable condition. I cite this simply to show what good results may be obtained by some plain, simple system. This principle of a uniform system is at the foundation of the successful operation of railroads as well as of other large corporations.

The distribution of coal-cars is, as a rule, very difficult, the mines, located on branches and spur-tracks, being badly scattered. The supply of empty coal-cars comes principally from the large manufacturing centers, where the coal is consumed, and in order to afford the mines in the various localities their equal proportions of the cars, it is necessary to keep in close touch with the movement of the empty cars in different directions. It is impossible for the men in charge of large terminals, like Chicago and St. Louis, to notify the Car Distributor at three, four, or five o'clock in the afternoon how many empty coal-cars they will be able to forward between six in the afternoon and six the following morning. The Distributor is, therefore, unable

to instruct the Superintendent or the Dispatcher how to divide, between his own and other divisions, the equipment he receives during the night. Consequently, the Distributor places an arbitrary distribution order on the percentage basis; for instance: 25 per cent. to Bloomington District, 25 per cent. to Springfield District, 30 per cent. to Chicago District, 20 per cent. to Champaign District; this order being in effect during the night. During the day, when it is possible to keep in closer touch with the forwarding of empty cars, they are distributed by train lots, or a given number of cars.

It is also the duty of the Car Distributor, Dispatcher, agent, conductor, and all concerned in the distribution and furnishing of cars, to see that large-capacity cars are furnished for shipments that will load to the capacity of the car, and that small, light cars are furnished for the light traffic. For example, it is not good policy to furnish an 80,000 pounds' capacity box-car to handle 6,000 or 7,000 pounds of merchandise, when it is just as easy to furnish a 40,000 pounds' capacity car. Neither is it good practice to furnish two 40,000 pounds' capacity box-cars for shipment of grain, when the shipment could have been loaded into one 80,000 pounds' capacity car. It is more difficult to haul the two than the one, and, in addition, they occupy double track-room in yards, and also entail double the switching expense on terminals.

The Car Distributor must keep in touch with the repairs to cars, in order that he may get the class of equipment which he requires for immediate use—i. e.,

box-, stock-, coal-, and refrigerator-cars—given preference on the repair tracks over the class of car which he does not so require. He should also keep informed as to the location of his cars on the tracks of foreign roads, so as to prevent too many of them getting into fields where they will be tied up and delayed. This information is furnished him from the car-record room.

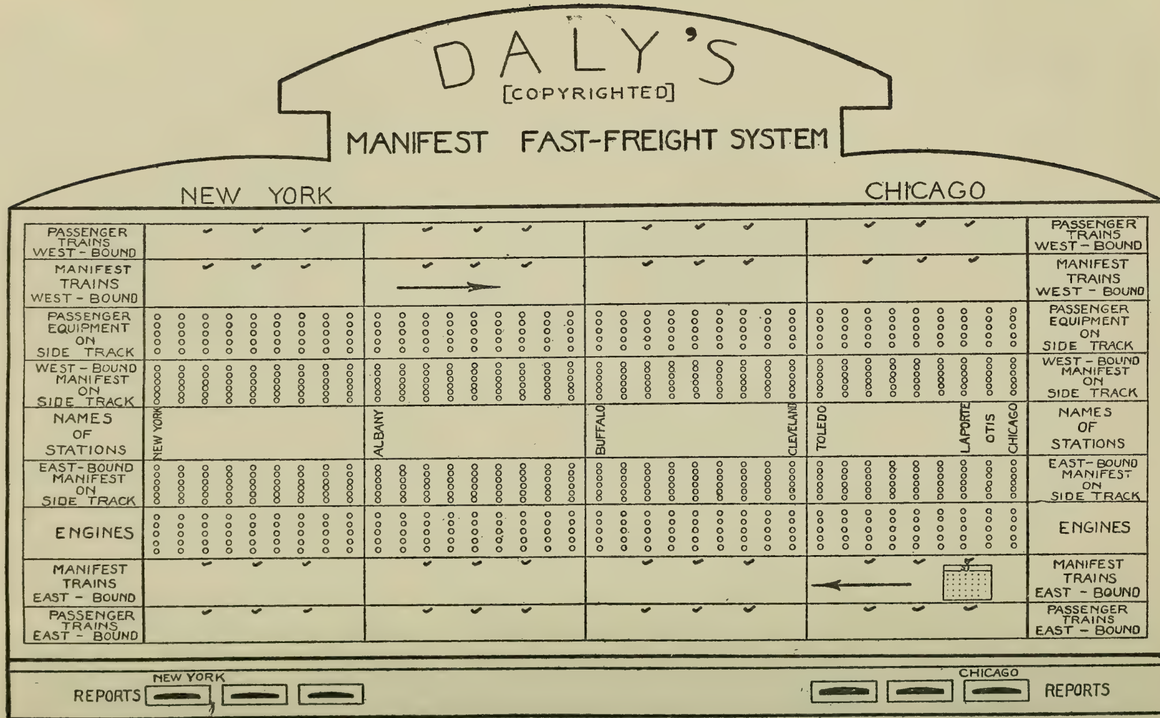
Each railroad car in existence bears the initials of the road owning it, and an individual number which remains with the car from the day it is built to the day it is destroyed. Railroads exchange information showing the disposition of each other's cars. For example, the Illinois Central loads ten cars at Omaha for Boston. When the ten cars are delivered to the Lake Shore & Michigan Southern at Chicago, the agent of the Illinois Central at this point makes a report to the Car Accountant of his own road, showing the initial and number of each of the ten cars, the date they were delivered to the Lake Shore, their contents, and their destination. When the Lake Shore delivers the ten cars to the New York Central at Buffalo, it mails to the Car Accountant of the Ilinois Central—because they are Illinois Central cars—a postal card giving the number of each car and date they were delivered to the New York Central. The New York Central, in turn, furnishes similar information, showing the date the cars were delivered to its connections. In addition to furnishing information showing the present location of the cars, this system also enables the owner to check their per-diem earnings. When the record shows that a connecting line has a great many more of our cars than we have of

theirs, the Car Distributor makes extraordinary efforts to get that connection to furnish us more of their cars, in order to protect loading originating on our line destined to points on theirs. This is especially true during the busy season, when there is a shortage of cars.

THE HANDLING OF MANIFEST FAST FREIGHT

In explaining the system of supervising the movements of cars loaded with high-class freight, or "fast freight," the accompanying model board may be of service. In the first place, it is necessary to define what is meant by "fast freight" and what commodities are considered "fast freight" and eligible for movement in "fast freight" trains. Each agent is provided with a small book of instructions covering the use of the blanks and the reports, and also showing the commodities eligible for movement in "fast freight" trains, and the commodities eligible for movement in "time freight" trains. For instance, perishable goods—such as meats, dairy products, merchandise, etc.—are "fast freight;" sugar, rice, coffee, and machinery are "time freight."

"Manifest freight" moves on a train scheduled at approximately twenty miles per hour; "time freight," on a train scheduled at about twelve miles per hour. The tonnage that the engine can haul on "manifest" trains at twenty miles per hour is about 30 per cent. less than the tonnage which the same engine can haul of "time freight" scheduled at twelve miles per hour, on account of the higher rate of speed; hence, it is more expensive to transport these high-class commodities than the lower grades of freight. For instance, the


DALY'S
[COPYRIGHTED]
MANIFEST FAST-FREIGHT SYSTEM
NEW YORK
CHICAGO
PASSENGER TRAINS WEST-BOUND
MANIFEST TRAINS WEST-BOUND
PASSENGER EQUIPMENT ON SIDE TRACK
WEST-BOUND MANIFEST ON SIDE TRACK
NAMES OF STATIONS
EAST-BOUND MANIFEST ON SIDE TRACK
ENGINES
MANIFEST TRAINS EAST-BOUND
PASSENGER TRAINS EAST-BOUND
NEW YORK
ALBANY
BUFFALO
CLEVELAND
TOLEDO
LAPORTE
OTIS
CHICAGO
REPORTS
NEW YORK
CHICAGO
REPORTS

agent at New Orleans loads a car of sugar for Chicago, also a car of potatoes for the same point. In billing the car of sugar, he takes the "time freight" waybill, printed in blue, and uses it to carry the car through to Chicago. On the car of potatoes he will use the "manifest fast freight" waybill, printed in red. If he also loaded a car of lumber, grain, coal, or other low-grade commodity, he would bill it on the ordinary waybill, and would use neither the "time freight" nor the "fast freight" waybill for it, as such commodities are not eligible for billing under the "fast freight" system of movement, in either of the above designated classes of trains, except where they are used to fill out such trains in the absence of sufficient of their assigned commodities.

In addition to these waybills, the yard clerk places a small card on the side of the "fast freight" and "time freight" cars. On the "fast freight" car the card used is printed in red, the same as the waybill; on the "time freight" cars the card is printed in blue, as is the case with the waybill.

This separate waybill for each car is used in order to give to each car an individual identity and rights in the train. Thus, in case the car is set out at any point, the waybill must be left with the agent at the station where the car is set out, and its peculiar construction and color will immediately call his attention to the fact that it is an important shipment which must not be delayed. If the agent fails to notice the importance of the shipment from the waybill in the rack, the yard master,

or switchmen, in going through the yard will locate the car by the card on its side.

Again, should a car billed "manifest freight" reach the end of a district, and the yard master fail to put it into the proper train to take it beyond, the clerk giving out the bills to conductors would discover the error of the yard master, by noticing this particular waybill, with its peculiar form of identification, in the rack, after giving the conductor all the bills he called for. He would then call the yard master's attention to his error, and possibly succeed in getting the car into the proper train before its departure, thereby avoiding a delay to the shipment and, later on, an investigation.

In this, as in every other branch of the service, *system* is at the foundation. By making the envelope for this waybill of a special size, by printing the waybill in red or blue, and by carding the car with the plain letter *M*, printed in red or blue, a particular identity is given it. Thus also anyone handling such car is notified that it should receive special attention. If no card were put on it, and the waybill were the common waybill used by railroads, only with a notation on the face or in the corner of it to the effect that it was "manifest freight" or "time freight," then we should not be assisting the switching crews, yard masters, agents, and conductors, in handling the cars as they should be handled or as we desire, and we should be creating openings for delays, instead of guarding against and preventing them.

After these high-class cars have been loaded at the house, or on team tracks, the bill clerks make up the

special waybills, filling out the blanks for "Station from," "To," "Contents," and "Consignee." The letter in the small diamond and the manifest number are not put on the bill until the train is made up and ready to go forward. For example, on the Illinois Central Railroad all the high-class commodities for the East from the terminal or adjacent points are assembled in the shaping-up yards at Chicago during the day and evening, then switched together into the proper assigned trains, and when the train is made up, the waybills are passed to the yard clerk, who sorts them out so that the car in the train destined for the nearest point will receive the lowest waybill number. For instance, we have in this train, say, one car for Cleveland, one car for Buffalo, one car for Albany, and twenty-seven cars for New York. The waybill for the car destined for Cleveland is the first, for Buffalo the second, etc., so that, when the car for waybill No. 1 is left at Cleveland, the agent can report its receipt without disturbing the consecutive numbering of the remainder of the waybills. After the yard clerk at Chicago has numbered these waybills, he makes his report on a "Form 35," which shows the manifest number assigned; e. g.: No. 1 for Illinois Central car 52480, destined for Cleveland, with butter and eggs; No. 2 for car destined for Buffalo; No. 3 for car destined for Albany; and Nos. 4 to 30, consecutively, for cars destined for New York. The yard clerk then sends this report to the Superintendent of Transportation, in whose office the board is located. The man in charge of the board takes a train block, marked, say, 51, that being the number of the

train. He takes Chicago's pegs numbered 1 to 30 and inserts them in this train block. Under peg No. 1 he puts the letter *D*, which shows it is destined for Cleveland. Under peg No. 2 he puts the letter *B*, which is Buffalo's cipher, showing the car to be destined for Buffalo, from Chicago. Under the next peg he places the letter *A*, which signifies Albany. Under the rest is the letter *N*, or New York's cipher.

This block, or train, when made up after this fashion, is placed on the hook (on the board) between Chicago and Cleveland for trains moving in the eastbound direction. When our train reaches Elkhart, the yard

clerk takes the waybills, runs through them, and finds that they are numbered consecutively from 1 to 30. He then reports by telegraph to the Superintendent of Transportation:

Manifest C–1 to C–30, arrived 2:00 A. M., left at 2:30 A. M.

Upon receipt of this No. 37 report, the man in charge of the board checks it against the train and finds it is O. K. He then passes the train block from the district Chicago to Elkhart over to the district Elkhart to Toledo, and puts this report in the drawer under the station named Elkhart, so that, in case he wishes to locate any particular car in the train, he refers to the No. 35 report from the agent at Chicago showing the manifest number assigned the individual car; and then, by referring to the Elkhart drawer, he can determine the time it arrived and left that point. In this manner the actual location of a car within two or three hours can be readily ascertained without further inquiries, making it a very valuable system for patrons of roads using it.

On the arrival of the train at Cleveland, the agent will report on the Form 37 as follows:

Manifest C–1 arrived at 5:00 P. M.——————————

leaving blank the forwarding column, for the reason that the car is destined for Cleveland and does not go forward. He next shows

Manifest C–2 to C–30, arrived at 5:00 P. M., left at 5:30 P. M.

At Cleveland the yard master adds five additional cars to the train. He telegraphs the Superintendent of Transportation the manifest number assigned each of these cars, the initial and number, and destination, on

the No. 35 report, as was done at Chicago. The clerk in charge of the board, upon receipt of this No. 35 report, places in this same train Cleveland's manifest pegs numbered 1 to 5, or 51 to 56, as the case may be, with the proper destination pegs under them.

When the train arrives at Buffalo, the agent at that point will report:

Manifest C–2, arrived at 3:00 A. M.________________________

that being the car from Chicago for Buffalo;

Manifest C–3 to C–30, arrived at 3:00 A. M., left at 3:30 A. M.
Manifest D–51 to D–56, arrived at 3:00 A. M., left at 3:30 A. M.

the last five being the Cleveland cars, *D*, being Cleveland's initial.

In case one of these cars was damaged or rendered unsafe for movement in the train at Laporte, Ind., and it was necessary to set it out at that point for repairs, the conductor in charge of the train, when leaving the waybill for the car, is obliged to telegraph the Train Master in charge of the district between Chicago and Laporte, and also the Superintendent of Transportation (Form 38), to the effect that he

Set out Manifest C–11 at Laporte on account of rough journal (or for any other cause).

When setting the car out, the conductor leaves with the agent at Laporte this manifest waybill for C–11. The man in charge of the board will, on receipt of this notice, take peg No. C–11 out of the train and insert it in one of the small holes opposite Laporte station by running it through the paper telegraph notice, the peg in the hole serving the same purpose as if the tele-

graphic advice was held on the board with nail or pin. This, of course, shows that there is a car of "fast freight," destined for New York, set out at Laporte.

In case the conductor forgets or fails to give this notice to the Train Master and Superintendent of Transportation, on the arrival of the train at Elkhart the yard clerk finds that he has all of the waybills consecutively numbered, 1 to 30, except manifest C–11. He therefore makes his report as follows:

Manifest C–1 to C–10, arrived at 2:00 A. M., left at 2:30 A. M.
Manifest C–12 to C–30, arrived at 2:00 A. M., left at 2:30 A. M.

This naturally shows that the car for waybill C–11 did not reach Elkhart, although it left Chicago in that train. The man in charge of the board will then take peg No. C–11 out of the train block and insert it in any station on that district with a blank report attached to it, showing that the car was set out of the train at some point which he is unable to determine; and he immediately wires the Train Master to have the conductor state where he left it. It then becomes the duty of the Train Master to get this information, and also to have the car repaired and moved in some slow freight train through to Elkhart during the next twenty-four hours, in order that it may be placed in Train 51 when that train is made up the following morning, and avoid stopping the "fast freight" train at Laporte to pick it up.

It will be seen that, by giving to each car an individual waybill and number, such car secures a separate and distinct identity, and is surrounded by checks; and also that, if the conductor should fail to report the setting-out of a car, the man in charge of the board will

immediately detect it, and prevent any unnecessary delay to the shipment by notifying the Train Master to look it up. If it were not for this individual check, the car would be overlooked and possibly remain sidetracked for a week, until some heavy damage claim resulted, which in turn would involve the conductor, and also the agent, in trouble for their failure to make a proper report. In other words, the object of the system is to prevent damage, and consequent loss, by forestalling delays instead of locating them after the damage has occurred.

The system is also intended to check the movement of trains over the different districts, for the purpose of seeing that they make their running time, and to locate the districts or the terminal points where they fail to run up to their schedule.

THE PROBLEM OF CAR SERVICE

WALTER E. BEECHAM, CAR ACCOUNTANT, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

The field of car service is the only one within the domain of railroad affairs that has not been thoroughly prospected for the introduction of economies, probably because of its vast extent and undefinable limits, and also by reason of the fact that it presents, at the threshold of endeavor, so many difficulties, perplexities and uncertainties that no one has had the courage to undertake a task of such great magnitude.

In all other branches of the service the cost of operation down to a scientific minimum is pretty well known; but no one can say how much might be saved, or how largely the earnings of railroads might be increased, if cars were handled economically, judiciously, and expeditiously. Scattered, as they are, over a vast expanse of territory, and hidden away on thousands of side-tracks in large terminals, it is not possible, with the facilities at the command of the roads, to exercise the close supervision over them which the enormous value of their use to their owners and the public alike imperatively demands.

Taking as an object-lesson, for the purpose of this paper, the Chicago terminals, in which twenty-five railroads and belt lines converge—beginning at South Chicago on the Calumet River, fourteen miles in a southeasterly direction from the Courthouse, and running westward to the tracks of the Chicago Belt, thence

north to Cragin and Galewood on the St. Paul, thence in a northeasterly direction to Evanston, embracing a radius of twenty-five miles within the switching limits, a vast territory in which thousands of cars are seen every day—we get a pretty fair conception of the magnitude of the proposition which confronts the railroads, and we realize how inefficient are the arrangements of today for successfully dealing with it.

The first and most serious difficulty met with, in considering the question, is the lack of information relative to the car situation in these large terminals, and how utterly inefficient are the means for gathering it. The next difficulty, nearly equal in importance, is the lack of co-operation on the part of the railroads themselves. I want to record my belief at this time that before any real reforms can be inaugurated in common terminals, the seat of 95 per cent. of the trouble, the railroads must place their switching power under the direction of a joint Superintendent of Terminals, representing all interests; and, further, the facilities for keeping in touch with the situation every hour in the day and every minute in the hour must be such as to meet the requirements. As it now is, the means of communication between railroads are inadequate to the demands; and before this difficulty can be remedied, a telephone exchange and ample telephone wires, assigned to this exclusive use, must be instituted. It is a self-evident truth that a railroad is no railroad without terminals, and it is equally true that, without close co-operation, the best results of operation in common terminals can never be obtained.

There are in the United States and Canada, in round numbers, two million freight-cars, representing an investment of one billion dollars in rapidly depreciating property. How to make each and every one of this vast multitude of cars render to its owner the fullest possible measure of service in its money-earning capacity is an undertaking worthy of the brains, genius, and energy of this great and unapproachably magnificent country—a land of unknown and unimaginable possibilities, fraught with so many promises of certain reward and material prosperity for those who have the courage and ability to take advantage of their opportunities, and perseverance to follow any occupation successfully.

It is asserted, with statistical accuracy, that there are in existence at this time enough freight-cars to provide amply for all the requirements of traffic conditions for some time to come, if they were properly distributed, and promptly and efficiently handled; but, nevertheless, no such shortage of cars has been experienced in this country in any previous years as the railroads now have to contend with. I do not want to be understood as unqualifiedly indorsing the proposition that there are cars enough for the prompt movement of all the traffic that is offered in any one day, or in any one week or month; and I doubt very much if it was intended to be thus interpreted, because that would be unreasonable. In the first place, if there were cars enough, they could not be handled; in the second place, if they could be loaded and moved promptly, the rush of traffic to common centers would be so great as in a

short time to block every railroad centering therein; and, again, it would be utterly impossible to find markets or storage for the products of the factory and farm. But I am inclined to the opinion that there are cars enough to provide for the actual needs and reasonable requirements of the present day, if they could be brought under proper and efficient control and employed to the best advantage. However, the magnitude and extent of railroad operations in this country make this a proposition of such bewildering possibilities and uncertainties, as well as of financial risks, that those responsible for the results of operation cannot at this time see their way clear to the adoption of the only scheme that is thought to hold out any hope or promise of solving the problems of car service, or of removing the evils that beset car supply.

It is an exceedingly difficult undertaking to explain many of the causes which contribute to the car shortage that annually afflicts the railways, because of the ever-changing conditions, and for the reason that they are general instead of local. Besides, our means of gathering information concerning the car situation, even from a local point of view, are very crude, inadequate, and unreliable. There is at the present time absolutely no way of telling where all the cars are, and, until we are able to do that, we cannot exercise as close supervision over them as is necessary in order properly to employ them.

Strange as it may appear, what supervision the roads have over their own cars does not extend beyond the owners' rails. Under the present practice, when a car

leaves the home road, it passes under the jurisdiction of another, and may not return to the owner's service for months and even years. There is a sort of understanding that a car belongs to the road that owns it, not to any road that happens to get possession of it, and there is some kind of agreement between the railroads that requires cars to be returned to the owners with reasonable dispatch—an agreement which is religiously lived up to when cars are not greatly in demand, but not very scrupulously observed when the demand is greater than the visible supply. Generally speaking, it is more honored in the breach than in the observance, and it quite frequently happens that cars are not returned to the owners until they are unfit for further service.

This is not altogether the result of retaining the cars in local service on any one line. They drift from one road to another, and travel from Maine to California, and from the line of the Canadian Pacific to the Southern extremity of the state of Florida, without once touching the home line for long periods of time. We chase them by wire and by letter, but without result. The wanderers refuse to return to the fold.

This is not a satisfactory condition of affairs and, in my judgment, is not a good thing for the railroads as a general proposition, but it is one of the almost insurmountable difficulties that confront us in handling cars.

Previous to July, 1902, it was the practice to pay mileage for the use of cars belonging to other roads. The rate in the early seventies was one and a half cents per mile run loaded, and nothing for empty mileage.

Later this was changed to three-fourths of a cent per mile, loaded and empty; and, again, to 6 mills per mile loaded and empty; at which latter figure it remained up to July, 1902, when the per-diem plan was adopted, and the rate for a freight car was fixed at 20 cents per day, with a penalty of 80 cents in addition for retaining possession of a car belonging to another road over thirty days.

The per-diem proposition was first publicly advocated in 1876 by Mr. J. T. Rigney, of the Baltimore & Ohio Railroad, in the first Car Accountants' Convention, held at Cleveland, Ohio. Mr. Rigney was not taken seriously at the time, because the idea was not considered practicable; but, as time went by, and the evils of the mileage plan became more and more apparent, the need of a change was more keenly felt, and the per-diem plan was adopted. The strongest advocates of this plan not only contended, and very reasonably so, that the per-diem basis was the only true one for settling car-hire accounts, but they went still farther and asserted, with just as much confidence, that, if per diem were adopted, it would accelerate the return movements of cars to the owners and very perceptibly increase the supply of cars on all roads.

These expectations have, however, not been fulfilled, save in the first few months after the plan was inaugurated. At that time it was an experiment. No one could confidently predict the result, and while 20 cents per day was little enough for a freight-car as an abstract proposition, it was readily seen that the large number of foreign cars that were in the possession of

non-owners at all times would make payments on account of car hire amount in the aggregate to very large sums of money. Hence an effort was made to hurry the cars back to their owners, with the result that we had a more plentiful supply of cars than usual at that time of year; in fact, it was difficult for some lines to find storage room for them, but that was at a time when cars were not very much in demand, and no road could afford to hold them even at the low rate of 20 cents per day, because they were not earning anything, mostly standing idle on the side-tracks. After the roads had recovered from their fright, however, and had fully realized that the interchange of cars was nearly even, and that consequently balances for car hire would not be very materially altered whether the rate was 20 cents or 20 dollars per day, they soon fell back into the old way of handling them; except, perhaps, that they were a little more particular to see that foreign cars did not stand idle on the side-tracks, or were not retained in possession when there was no use for them. In other words, the roads very generously surrendered possession of a foreign car if they had no use for it; and that seems to be about the size of the situation at the present day. Upon reflection, it will readily be seen that it could not be otherwise, and that all the fault for such a state of affairs rests with the railroads themselves, which have always rated their individual interests higher than their mutual interests, and have been ever ready to sacrifice the latter for the former, whenever deemed necessary or expedient or politic, under the plea that self-preservation is the first law of nature.

albeit forgetting entirely that in unity there is strength.

If the railroads were not engaged in handling interstate commerce, this policy would undoubtedly be the true one, as in that event there would be no mutual interests in which the equipment was involved; but interstate commerce forces the railroads to interchange cars whether they desire to do so or not. It has no regard for the wishes of the railroads with respect to the use to be made of their equipment, and distributes cars throughout the length and breadth of the land without reference to what the railroads may or may not think about it.

It seems to me that this condition of affairs, which it is beyond the ability of the railroads to change, can be met and successfully combated only by united action. When cars are drifting with the flow of traffic, in large numbers in one direction, it is impossible to wait for the return tide to drift them back again. Steps must be taken, therefore, to force them back against the prevailing tide; otherwise they will as naturally drift with it into all parts of the Union, as a stone, thrown into the air, obeys the law of gravitation and returns to the earth. There is only one way in which this can be accomplished, and that is by placing the distribution of equipment, as among railroads, in the hands of an organization especially adapted to that line of work—an organization which not only will be representative of mutual interests, but will be endowed with sufficient authority to enforce its mandates upon all concerned, with impartiality and equity, and without fear or favor, in a manner similar to that in which the distribution is

now supervised on any of the large systems. That there is abundant precedent for believing that such a plan as this would be successful, one has only to investigate the results that have attended the consolidation of several large systems in recent years.

Take the Pennsylvania Lines, for example, which own and control more freight-cars than would be included in a pool of equipment embracing the North-Western, Chicago, Milwaukee & St. Paul, and Burlington lines; or, say, between 160,000 and 175,00 freight-cars of all kinds. Will anyone undertake to say that this vast equipment cannot be more economically employed, efficiently distributed, and promptly handled under one management than under two or more different managements, each one working independently of the other and permitting its selfish interests to blind its eyes to the common good? Has it not been demonstrated time and again, in many ways, that it is necessary to put the distribution of equipment in the hands of one man, even on such a system as the St. Paul, in order to protect the requirements of its several divisions? And why? Simply because the out-bound from some divisions is so much greater than the in-bound that it is necessary to keep them constantly supplied with empty cars, as otherwise they would go out of business for the want of cars to load.

At a recent meeting of car-service officers, held in Chicago, I read a paper on this subject, and one of the members, in commenting thereon, wanted to know what we would do when there were no cars to distribute. I told him that such a condition would never

exist; that there would always be cars to distribute; that there must be cars to distribute, whether there were or not—paradoxical as that may appear. This reminds me of an incident that occurred many years ago. The General Manager of the St. Paul road—a man of wonderful energy and strong character, but of very explosive temperament, which was liable to blow up at any time and in unexpected places—ordered a Train Dispatcher to send some empty flat cars to Bay View for rails. The Train Dispatcher answered that he could not, as he did not have the cars. The General Manager replied, in tones that none of us ever mistook: "Don't you tell me you cannot send cars when or where I tell you to;" and he walked out of the Train Dispatcher's office. It is needless to say that the cars were promptly sent.

The evils that afflict the car supply are principally due to a lack of co-operation on the part of the railroads, and to delays in common terminals. It is at this latter point that reforms must begin; and perhaps the first step will be the pooling of the switching power. But as this subject leads me away from my theme, I will not pursue it any further at this time.

Two of the best examples of the proper management of equipment are offered by the Pullman Company and the Armour car lines. The cars of the Pullman Company are distributed all over the United States and Canada, and are managed with consummate skill from the general offices in Chicago. This is passenger service, it is true, but the principle involved is the same. The Armour car lines' management is above criticism

from an operating view-point—nay, it is more than that, it is superb and incomparably superior to anything of a like nature. They own the cars and a large share of the product carried, and thereby enjoy exceptional conditions; but I am speaking now from my knowledge of the handling and maintenance of the equipment, and the methods of supervision employed, both from a mechanical and from an operating point of view. Their relations to the public have been defined with exceptional ability by Mr. J. Ogden Armour in a series of articles in the *Saturday Evening Post,* and need no defense at my hands. But I cannot, at this time, refrain from saying that I have no sympathy with the attacks now being made on corporations of all kinds. I consider that the private car lines now in existence fill a legitimate place in transportation affairs; and I presume they were instituted for the purpose of gain. I have never known money to be invested in such enterprises from purely philanthropic motives, or for sanitary reasons, or for the good of the public health, or even because the investors were anxious to put money into circulation; and those who have the brains, energy, and courage to organize, and the aptitude successfully to manage, such large affairs are entitled to the rewards of material prosperity. I have no sympathy with any attempt to get it away from them, except through the medium of barter and trade.

One of the best showings made of the results under an equipment pool is to be found in the *Railway Equipment Register* for February, 1906. About a year and a half ago, the Union Pacific, Southern Pacific, Oregon

Short Line, and Oregon Railroad & Navigation Company established a clearing-house for the purpose of pooling their equipment; and in the last annual report of the Union Pacific Company appears the following comment as to the results attained:

The clearing-house, put into effect this year by the companies for the common use of their rolling-stock, was an important factor in the excellent results attained by the Transportation Department. By this clearing-house system of distributing cars there was effected an increase of 1.60 cars in the average number of loaded cars per train, and also a gain of 1.55 per cent. in the percentage of loaded freight-car mileage to total freight-car mileage, representing a saving of about 5,726,992 empty car-miles.

A recent issue of the *Railroad Gazette* presents some figures obtained from Mr. J. Kruttschnitt, Director of Maintenance and Operation, showing the results under the clearing-house system, with comment thereon as follows:

	Year Ending June 30		Increase or Decrease	Per cent.
	1905	1904		
LOADED FREIGHT CAR MILES				
Union Pacific System ..	269,763,446	240,405,820	Inc. 29,357,626	12
Southern Pacific Co....	344,926,922	338,783,730	Inc. 6,143,192	2
Total	614,690,368	579,189,550	Inc. 35,500,818	6
EMPTY FREIGHT CAR MILES				
Union Pacific System ..	99,719,947	96,008,791	Inc. 3,711,156	4
Southern Pacific Co....	140,793,852	158,982,665	Dec. 18,188,813	11
Total	240,513,799	254,991,456	Dec. 14,477,657	6
Grand total	855,204,167	834,181,006	Inc. 21,023,161	3

RATIO EMPTY CAR MILEAGE

Union Pacific System ..	26.99	28.54	Dec. 1.55
Southern Pacific Co....	28.99	31.94	Dec. 2.95
Total	28.12	30.57	Dec. 2.45

This illustrates in a striking way the great saving which has been made in movement of empty cars; which means, of course, a consequent increased availability of equipment for securing loads. Had the 1904 ratio of empty mileage prevailed in 1905, the empty car-mileage would have amounted to 261,435,000 miles, or nearly 21,000,000 freight-car miles in excess of the actual figure. This saving is roughly equivalent to 500,000 freight-train miles; that is, the 1904 ratio would, with an average of 42 cars to a train, have required the running of 500,000 more freight-train miles. Since the close of the fiscal year covered by the table there has been especial opportunity for efficiency in handling equipment to be shown because of the unusually severe car shortage and the constant heavy demands on the equipment. In the four months ending October 31, 1905, the ratio of empty car haul was still further reduced 1.15 per cent. on the Union Pacific, and 1.19 per cent. on the Southern Pacific—an addition of nearly one-half to the saving in the fiscal year 1904–1905. Results as favorable as these speak for themselves for the success of the equipment clearing-house as a measure of operating efficiency.

If a few railroads find the pooling of equipment so greatly to their advantage as this indicates, it is hard for the human mind to estimate the beneficial results that might follow the pooling of equipment in general, and the placing of it under the sole charge and control of experienced car distributors.

The general public looks upon pools of all kinds with alarm, and it is popularly believed that dark and damnable conspiracies against the peace and good-will of the commonwealth are concealed within their innermost

recesses, and that they are stirred only with evil intent toward the people. But whatever of truth there may be in this does not apply to a car pool; in fact, the idea suggested is only the culmination or completion of what is now almost a fact, and for which interstate commerce is responsible.

Loaded cars are pooled in handling interstate commerce, whether railroads are agreeable to it or not. In fact, railroads could not operate without interchanging loaded equipment, or pooling it. My idea is to carry this a little farther and pool the empty equipment, or such cars as may be designated as the circulating medium of equipment—the standard box-cars—in order that the railroads may have it within their power to distribute the empty equipment to offset the distribution made by the shippers of the loaded equipment. If such an arrangement as this could be perfected, it would be necessary to divide the country into districts, so many roads to be embraced in one district, and to be under the charge of a district distributor. Then two or more general distributors, having jurisdiction over all, would have to be appointed, who would soon work out the necessary details for the successful operation of the plan.

FREIGHT CLAIMS

RALPH C. RICHARDS, GENERAL CLAIM AGENT, CHICAGO & NORTH-WESTERN RAILWAY

When property is delivered to a railroad company or other common carrier for transportation, the carrier must transport it to its destination with reasonable dispatch at the agreed or published rate, and deliver it to the consignee in the same condition as that in which it was received. If it fails so to do, it must pay the owner its value, if lost; or compensate him for the damage, if any is done; unless such failure is caused by the act of God or the public enemy. In some of the states this liability as an insurer continues after the property is unloaded at its destination from the cars into the warehouse and is ready for delivery, until the consignee has had a reasonable time—depending upon the circumstances, but generally from twenty-four to twenty-eight hours—to call and remove his property. In other states—Illinois, for instance—the carrier's liability as an insurer ends as soon as the property has been unloaded from the cars and is ready for delivery. After that time the carrier is liable only for loss of or damage to the property caused by its negligence; and in order to recover, the owner must prove the negligence.

Because of the failure of the carrier always to perform this duty, claims are made against it for loss of the property which it fails to deliver, for damage to

articles which has occurred while they are in the possession of the carrier, and for charges made in excess of the published or agreed rate. In ordinary railroad parlance, claims arising from the first two causes are called "freight claims;" those arising from the latter are called "overcharge claims." The first class is the subject of this paper.

Generally speaking, claims of this nature are investigated and adjusted by an officer know as the Freight Claim Agent; but on some lines, usually the smaller ones, this investigation and adjustment are made by the General Freight Agent or Auditor; on others, by the General Claim Agent, who also has charge of the investigation and adjustment of personal-injury and other claims. The investigation is usually by correspondence.

The duty of the Claim Officer is not only to investigate and adjust claims, but also to ascertain the cause of the losses, to recommend the adoption of proper measures for the safe and expeditious handling of traffic, thereby preventing losses and damages from occurring in the future, and to educate the employees as to the rules and how the work should be done; or, in other words, to stop the leaks.

There are about 210,000 miles of railroad in the United States, employing nearly 1,300,000 men. For the year ending June 30, 1903 (the last year for which the Interstate Commerce Commission has published its report), there were transported 173,000,000,000 ton-miles of freight. I estimate that the number of claims presented to the different railroads during that year

was 1,600,000 or 1,700,000—about 8 per mile per annum—costing the companies about $5 per claim, or an aggregate of $8,500,000—about $40 per mile of road operated. This does not include the value of equipment and track damaged or destroyed in wrecks, in which part of the property for which claims are presented was damaged or destroyed, or the cost of picking up such wrecks, which would probably be about $2,500,000 more; and I think a comparative estimate of the amount paid as wages to men engaged in investigating and adjusting such claims would be $850,000, or 50 cents per claim; making the total cost $11,850,000, or nearly 1 per cent. of the freight earnings as reported by the Interstate Commerce Commission for that year, which were $1,338,000,000.

Whether the business of carrying this immense tonnage is profitable depends upon the cost of handling it. One of the items of cost is the amount paid out for loss and damage, which I estimate to have increased about 400 per cent. in the last seven years, while during the same period the freight earnings have increased 53 per cent. If the other operating expenses had increased at the same ratio, there would have been not only no profit from operations, but an absolute loss. Consequently the matter of loss and damage claims, which previous to 1898 was a comparatively insignificant charge, has become, from its large increase a matter of anxiety to the owners and managers of railroads, and the question of how to reduce that loss has lately been given attention and consideration. In order to reduce the charge, it is, of course, necessary

to ascertain its cause; when that is known, the remedy ought to be easily determined and applied. While the ratio to the total freight earnings the country over is about 1 per cent., it differs on different roads, for reasons which I shall try to explain.

Nearly all claims are adjusted or arranged in a manner satisfactory to both the claimant and the carrier, much less litigation resulting from them than one not acquainted with the business would suppose. On the line with which I am connected we had, during the year ending June 30, 1904, 58,146 freight claims and but 32 lawsuits, the ratio being so small as to be not worth considering. Many claims—I think at least one-half of those presented on local shipments—are disposed of inside of a week after their presentation; indeed, a large portion of them are adjusted on the day of their presentation. Claims for loss or damage on shipments passing over two or more lines take longer to investigate, but I believe the average time taken to investigate and settle all claims is less than sixty days, although occasionally such claims are unreasonably delayed in adjustment, on account of the dilatory methods of claim officers, of the neglect of agents in answering and attending to correspondence, and of the failure of some of the companies to provide a sufficient force to do the work promptly and properly.

An association known as the Freight Claim Association, composed of nearly all the railroads and steamship companies of this country and Canada, has adopted a code of rules for the investigation and division of line claims, which has immensely improved methods here-

tofore in vogue and greatly expedited the adjustment of claims. Where the members cannot agree upon such division, the matter is decided by an arbitration committee elected each year by the members of the association, by whose decision all members are bound, although they have the right of appeal to another committee—which right, however, is rarely exercised.

The number of freight claims made against a carrier, like those for personal injuries, depends not so much upon its mileage or tons carried—which, of course, must be considered—as upon the kind and amount of traffic handled; the character of the people and the population of the country through which its lines run; the class of men engaged in the carrier's service, and their familiarity with the rules; and the quantity and quality of supervision exercised over the employees. For instance, take one of the transcontinental roads, with freight earnings of about $36,000,000, whose business is largely in carload lots, which go through from shipping-points to destination without breaking bulk; its claims amount to about $70,000. Another line, operating both in the North and the South, with freight earnings of about $31,000,000, whose business is largely in less than carload lots, which are frequently handled and transferred; having employees who are, perhaps, less prompt and careful than those wholly in the temperate latitudes: its claims cost about $500,000. A third road, operating in the northern and central tier of states, whose business is even more largely in package freight than the last-mentioned, with freight earnings of $38,000,000, but which has, perhaps, a

higher grade of employees, and more and better supervision, the communities tributary to it being more conservative and less litigious than those tributary to the second-mentioned road: its claims amount to $300,000. These examples will, perhaps, serve to illustrate what I have just said about the reason for the difference in the number of freight claims on different systems.

When property is received by a carrier, it should first be examined to see that it is properly crated to stand transportation, and marked with the name of the consignee and its destination, in accordance with the shipping directions; then a receipt or bill of lading should be issued for it. As this receipt is evidence of the contract and, like a note, is good for the value of the property it calls for, and the carrier must deliver the goods or pay for them, care should be taken to make it correctly, and not only the name of the consignee and the destination of the property, but the number and condition of the packages and the rate, if one is agreed upon, should be shown. Subsequent to its receipt, a waybill is made for the consignment, which should accompany it. Then it must be properly loaded in the car, transported, unloaded, delivered to the consignee or on his order, and a receipt taken for it. All of which sounds very easy and simple; but, because it is not always done, a loss or damage occurs, and, as a matter of course, a claim follows.

From an experience of many years in handling matters of this kind, I have learned that a large amount of this annual loss is caused (1) by want of sufficient supervision; (2) by carelessness and thoughtlessness of

employees; (3) by employees' lack of knowledge of and familiarity with the rules regulating the manner of handling the traffic, and failure to realize the result of non-compliance with the same; (4) by neglect on the part of shippers properly to crate and mark the packages, which results not only in damage to the contents, but also in their failure to reach their proper destination. The part of the trouble which I shall discuss is that mentioned under the second and third heads. By way of illustration, I shall cite some cases to show the result of such carelessness. They may be subdivided into the following heads:

A. Receipting for more freight than is actually received, or receipting for the same in good condition when it is in bad order.—(*a*) An agent gives a receipt for ten packages of oranges without counting them; when the shipment reaches its destination, there are only nine; a claim is presented for one short, and must be paid. (*b*) A shipper loads a car of butter, and presents a receipt to the agent which specifies 500 tubs of butter; the agent does not check the consignment, and does not know whether there are 500 or 300 tubs in the car, and signs the receipt without making the notation "shipper's load and count;" the shipper takes the receipt, makes a draft on the consignee for the value of 500 tubs of butter, and attaches the receipt to the draft, which is paid by the consignee; the car reaches its destination; the consignee presents the receipt for the 500 tubs of butter; there are only 300 tubs in the car, and the result is a claim for the value of the 200 tubs, which could have been avoided if the notation "shipper's load

and count" had been put on the receipt. (*c*) An agent receipts for a lot of stoves or furniture in good order, when an examination would have shown that it was in bad order; the property reaches its destination; the consignee presents his good-order receipt; the stoves or furniture are damaged, and a claim is made, which would not have been done if the receipt had shown the condition of the goods.

B. Waybilling freight to a wrong consignee or destination.—(*a*) A car of household goods is shipped from Omaha to Geneva, Nebr.; the agent bills the car to Geneva, N. Y.; the car goes to New York; the owner, to Geneva, Nebr.; the car is finally brought back; the road whose agent made the mistake has to pay for the extra haul of the car, and allow something for the additional expense to which the owner of the goods was put while waiting to get them back from New York. (*b*) Twenty cases of shoes are shipped from Chicago to Kankakee, consigned to John Smyth; they are billed to John Smith, and by mistake are delivered to John Smith, who is dishonest and financially irresponsible; John Smyth presents his bill of lading, and the company responsible pays the claim; it tries to collect the same of John Smith, but nine times out of ten fails. Both losses would have been avoided if, after the waybill was made, it had been compared with the shipping directions, as the error would have been discovered at that time and corrected; the rules require this to be done, but often it is not complied with.

C. Loading freight in one car, but billing it in another.—A shipment of dry goods is billed in car 54569;

it is loaded in car 5456; car 54569 reaches its destination with the dry goods short; car 5456 goes to some connecting line, and the billing road never hears of the dry goods except in the way of a claim.

D. Failure to see that all packages are marked with the name of the consignee and the destination.—A shipment of ten cases of fine machinery is made from Milwaukee to Memphis; nine of them are marked, one is not; the car goes through to Cairo, where it is transferred; the nine marked cases go to Memphis; the other one, not being marked, is held over at Cairo; it is put away and forgotten; a claim is presented for the one short, which, of course, is the most valuable of the lot; it cannot be found, and has to be paid for. If the rule requiring the marking of all packages had been complied with, the whole consignment in all probability would have reached its destination.

E. Transferring freight carelessly.—A shipment of rugs and wedding presents is made from San Francisco to Washington; it is carried from the shipping-point to Chicago, where it is checked short, although really in the car, and by mistake is put with another lot of household goods, going to Newark, N. J., consigned to another consignee; it goes to Newark, and is sent to a warehouse with the other goods; a claim is presented for $1,200 or $1,500; it has to be, and is, found, and finally properly delivered. The mistake would have been avoided if a proper check had been made at transfer points, either in unloading the original car or in loading the shipment with which this consignment was by mistake mixed and loaded; or if the contents of the

car in which it was loaded had been properly checked at Newark.

F. Improper loading and crating of freight, and rough handling of cars.—A type-setting machine, valued at $2,500, is shipped from Marinette to New York; it is not properly crated and is insecurely loaded; when it reaches its destination, it is not worth unloading; a claim is presented for its value, and paid. This would have been avoided if the agent at the shipping-point had had the machine properly crated and put the expense on the waybill as advances, if the shipper declined to do the work; or if he had taken the trouble to see that the machine was properly secured in the car; or if the trainmen had handled the car carefully.

G. Delivering freight to the wrong person or without an order from the consignee.—(*a*) A case of dry goods is billed to A. S. Peterson, but is delivered to A. E. Peterson; a claim is presented by A. S. Peterson, who holds the bill of lading, and it is paid; A. E. Peterson leaves within two days, and is heard from no more. (*b*) A barrel of sugar is billed to C. S. Williams; it is delivered to a drayman, who claims he hauled it to Williams' store; Williams claims he did not receive the sugar and refuses to pay for it; the shipper presents a claim; the drayman did not have an order from Williams to haul his freight; it is unnecessary to say who pays for the sugar.

H. Delivering "Order or Notify" freight or shipments for which a negotiable bill of lading is issued without requiring the surrender of the bill of lading.—

A car of wheat is billed to the order of Armour & Co., notify John Jones; the delivery is made to Jones without his surrendering the bill of lading properly indorsed, which Armour has sent through a bank with a draft for the value of the wheat; Jones, of course, after getting the wheat forgets to pay the draft, and the carrier has to do so.

The rules prohibit such deliveries as those described under F and G; but agents fail to comply, and loss thereby results.

A freight claim is presented by the claimant direct to the Claim Officer of the carrier, or to the agent at the place where the claimant resides. When received at the Claim Office, it is immediately entered in a register kept for that purpose, given a number, and then examined by the Claim Officer or his assistant. If sufficient information is furnished at that time, it is immediately disposed of; if additional information is necessary, the matter is given to an investigator for further inquiry. When the facts are ascertained, the claim, if meritorious and reasonable, is paid, or, if not a just charge, declined. If the amount is deemed excessive—it is never too low—that matter is negotiated, and some agreement or compromise is reached. Fortunately, in the very large majority of cases the amount is reasonable, being based on the invoice price of the merchandise lost, or, if damaged, by the cost of repair, with freight charges added. Generally the payment is made by the Claim Officer drawing a check for the amount and mailing it to the claimant, the check expressing on its face what it is for, and its indorsement acting as a

receipt. Where line claims are paid, the carrier to whom the claim is presented makes the payment, and bills on the other carriers interested in the claim for their share of the loss or damage. Losses are divided according to the revenue which each carrier interested in the matter received; damages, according to the mileage each carrier transported the property.

I have attempted to explain briefly what freight claims are and their cause. I learn from men in this line of work in England, Scotland, and Canada that the railroads there are suffering to the same, if not to a greater, extent from the same trouble as we in this country. There always will be some losses and damages as long as railroads are run by men, who are pretty much the same everywhere; and the only thing we can do is to try to reduce them to the minimum. We all hope that they have reached the maximum, and that the pendulum will soon swing the other way. It is now doing so on the Chicago & North-Western Railway, where we advertise to have, and do have, "the best of everything." The following suggestions, if adopted, would, I think, help some in bringing about a reduction in claims:

1. As men are the important equation on a railroad, we want a new method of hiring them, so that we shall get the highest class that the wages paid and the chances of advancement in the service—which are great—will hire. To do this, the railroads should have a bureau of employment, with a first-class man at the head, for the purpose of selecting the right man for the right place—a method or system under which at least

as much care will be taken in the selection of *men* as is now taken, with such good results, in the selection of *things,* such as engines, cars, rails, etc.; as, after all, men are, always have been, and always will be more important than things; and as the personal equation at the head of an institution goes a long way in making a success or failure of the enterprise, the same rule ought to work down as well as up.

2. We want the right kind of rules regulating the handling of the traffic—the fewer and simpler the better. I think it was Longfellow who said: "In character, in manner, in style, in all things, the supreme excellence is simplicity;" and that saying is as true about railroads and their rules as it is about everything else.

3. We want some method of teaching the employees what those rules are, and of explaining to them their necessity, and the result to the company, the patron, and the employee if they are not observed; and, above all things, to impress on employees that, while it is no crime not to know all the rules and just what they ought to do under all circumstances, it ought to be a crime, when they do not know, not to ask someone who does, and learn before, not after, they act, as it takes less time to learn to do a thing right than it does to explain why you did it wrong. The present method of sending out half a dozen books of rules containing from 100 to 200 pages each, and expecting the employee to learn and understand them without such instruction, is not what it should be, and sooner or later—sooner I hope, for the good of all—will be changed. And that

is one of the things that the University of Chicago, by this course of study, is helping to bring about, and which, if carried to its legitimate end, will result in great benefit both to the railroads and to their employees.

4. We want more and better supervision—the kind that really supervises, and which should increase in quantity as well as in quality in at least the same proportion that the traffic does. Poor Richard said that "the eyes of the master will do more work than both his hands;" and that saying is just as true now as when Benjamin Franklin uttered it over a hundred years ago.

SOME NOTES ON FREIGHT RATES

The most obvious feature of railroading is that of physical operation—the movement of locomotives and cars, and the maintenance of equipment, roadbed, structures, and buildings. It is not to be doubted that the management of these varied operations requires the greatest skill and the highest ingenuity in those who achieve success. The problems that have to be faced are sometimes exasperatingly difficult even to the men who have spent a lifetime in solving them. Yet there is a branch of railroading whose difficulties may well be considered to outvie even those connected with the direction of physical transportation, and in the conduct of which there are a hundred chances of failure to one of success. Its general principles, if there are any, are so illusive and intangible that each problem has to be analyzed and its solution determined almost independently of any other. And though this branch has nothing to do with the building of the roadbed, the maintenance of track, or the operation of locomotives, it is in reality the essence of railroading, since upon its successful handling depend the commercial success of the railway and its vitality as an operating concern. Probably more mistakes have been made in rate-making than in all other branches of railway work combined, and with greater ill effects. On the other hand, much of the actual adjustment of rates has been of unparalleled benefit in stimulating the economic growth of the

country both as a producer and as a trader. That errors have been and will be made in rate-making is not surprising in view of the complexity of any trade situation to which a freight rate has to be applied. A great deal of intelligence has been given to the work by traffic officials; and yet, with all of this, it would seem as though still more is demanded.

It has been said that the term "rate-making" is inappropriate, that the railway does not possess such a power, and that its work is simply that of recording from time to time the conditions determining the rate. In a sense this is true; but it is obvious that, in so far as the railway does not respond truly to the economic environment, its rate record will be all out of tune. Everybody has more or less vaguely been aware that a railway is limited in the arrangement of its tariffs by considerations, first, as to securing traffic, and, second, as to moving the traffic at a profit. These purely commercial considerations limit the variation of rates, but within their limits there is wide possibility for any rate or series of rates to be established which is far from representing the ideal response to the real necessities of trade and industry. In fact, the perplexing intricacy of rate relations is a powerful argument, with the railway rate-adjuster, to make no change save that which is obvious to his own intelligence as being in the financial (sometimes political) interest of the railway. As a consequence, it is not impossible to find very peculiar rate relations existing at competitive, and even at non-competitive, points.

I have one case in mind now where a branch line

taps a main line and then runs through practically its own territory for a distance of some 130 or more miles. The local rates from Chicago are 68 cents per 100 pounds on first-class freight to the junction point, 80 cents to the next station on the branch line 11 miles away, and the same to the remaining 120 or more miles terminating at another junction point, which, in common with other places, sets the 80 cents rate. In determining the proportional rates from the Mississippi River on traffic originating east of the Illinois–Indiana state line, the proportional from the river to the first junction point is 40 cents, and then increases with the distance (the stations being classified into several groups) to 45, 47, 49, 55, and finally to 60 cents, this being the proportional rate to the competitive junction point previously referred to as the terminus of the branch line. Here there are in operation over the same stretch of line two rate policies which seem inconsistent with each other, and hardly to be justified on the ground that one system applies to through rates and the other to locals. As already stated, it is hard to understand rate relations of this kind, except by attributing them to a natural desire to avoid any rate adjustments except such as competition or immediate financial advantage demand.

Several interesting illustrations of the intricacy of rate relations are to be found in the evidence given by railway officials before the Industrial Commission. For instance, the rates from the West to Mobile, Ala., were determined, under the policy established by the Mobile & Ohio Railroad, by the rates to New Orleans,

which were necessarily fixed very low on account of water competition. It was felt that the railways could not afford to put into effect at points to the north of Mobile the low rates enjoyed by the latter. Hence the rates to such points were on a much higher level, though applying to shorter distances. In fact, the evidence revealed that it was possible to ship certain commodities to such a point as Montgomery, Ala., through to Mobile, 175 miles farther south, reshipping at that city back to Montgomery, at a cheaper rate than could be obtained by direct shipment. The local rate from Mobile to Montgomery, it may be noticed, was kept low by the competition of the Alabama River. The inconsistency was allowed to exist by the railways for fear that the reduction of the direct rate to Montgomery would necessitate reduction at other trading centers in the adjacent territory. The whole situation in this territory well illustrates the intricacy of which I have been speaking. Montgomery rates are influenced by Mobile rates, Mobile rates by New Orleans rates, and New Orleans rates by the river rates to St. Louis. The St. Louis–New Orleans rates necessarily affect the Chicago rates, and, in turn, a host of others. Though Galveston is 350 miles or more to the west of New Orleans and the Mississippi River, its determination to compete with the latter city adds still further to the complexity of the rate situation. Obviously, the rival interests of Chicago and eastern manufacturing centers have to be satisfactorily balanced. Bearing this in mind, it will not be difficult for the student to understand how the

alteration of the rates effective between St. Louis and New Orleans might affect literally thousands of other rates.

It is not to be wondered at that inconsistencies exist under such conditions, some of them almost inexplicable. It might well puzzle even a traffic man to give satisfactory explanation why grain rates from southeastern Minnesota—for instance, the district between Albert Lea, Minn., and La Crosse, Wis.—to southeastern territory should be based on a differential of 6 cents in favor of St. Louis as against Chicago. St. Louis is nearer southeastern territory than Chicago, but Chicago is much nearer the originating territory than its sister competitor. La Crosse, by the Chicago, Milwaukee & St. Paul Railway is 283 miles from Chicago; Albert Lea, by the Minneapolis & St. Paul Railroad, the Iowa Central Railway, and the Wabash Railroad, is 478 miles from St. Louis. Under these circumstances it might have been presumed by the uninitiated that the differential granted to St. Louis would have disappeared in this territory. Of course, the reply given to the inquirer would be that the differential was upheld by the direct competitive route established into St. Louis. The cause of the difference is obvious, its logic less so.

The methods adopted in fixing rates, by the railways both of this country and abroad, have subjected them to much criticism, and considerable attention has been given to reform schemes proposing to place rate-making on a simpler basis, and incidentally to relieve the railways of the power of discrimination. The

two principal theories of rate-making advanced by the reformers rely, in the one instance, on distance as the only proper measure of a rate, and, in the other instance, on cost of service. The impracticability of constructing rates on either of these bases alone is demonstrable. On a traffic of 1,000 tons *a day* from A to B the connecting railway could enjoy its normal percentage of profit, and yet charge a considerably lower rate than for traffic between A and some point C, an equal distance away, amounting to only 1,000 tons *a month*. Within certain limits, railway operation, like manufacturing, is subject to the law of increasing returns—the more the freight there is to be carried, the cheaper it can be carried. Physical conditions are also to be taken into account in considering distance as the only basis for railway rates. Of two railways operating from the same center, the lines of one may traverse broken and mountainous country, while those of the other may pass through a practically level region. The operating expenses of the former will be seriously greater than those of the latter—the same motive power equipment and the same expenditure of fuel and water will haul nothing near the same number of loaded cars to a train—and the cost of maintenance of equipment and track will be substantially heavier. Given a similar quantity of traffic to be moved and a similar distance to be operated over, it is perfectly clear that rates which would give the level road a normal profit would simply spell ruin to the hilly road. Hence, as the sole basis of rate-making, distance fails. Yet it it true that to transport a train-load of freight 500

miles costs more than to carry it but half that distance, and to that extent distance must be considered to constitute a part of the composite basis of rates. The "equal mileage" theory, as generally propounded, proposes to retain a proper classification of commodities, but demands that to each commodity a uniform rate of so much per ton per mile be applied. As already appears, this ignores the fact that the cost of carrying the freight 250 miles will be much more than half the cost of conveying it 500 miles, assuming that the physical formation of the country along the whole route is about the same. The cost of terminal handling is a very important item in the total expenses of transportation, and these will approximate the same whether the distance hauled be long or short. Once the cars are loaded and the train made up, the additional expense incurred in moving that train an extra 250 miles forms but a small percentage of the total charges against that train.

Cost of service as the sole basis of rate-making recognizes the factor of distance in the sense just explained, but is impossible because impracticable. If one could definitely ascertain the cost of carrying any proposed consignment of freight, allowing in the calculation for both transportation and standing expenditures, there would at once result an easy solution of the problem of finding a rate basis that would carry with it its own justification. Its application would free the railways from impeachment on the grounds of favoritism and discrimination. Unfortunately, our limited wisdom does not enable us to determine scien-

tifically the way to distribute the cost of train-working over the hundred and one things that may elbow one another in the same freight-car and in the same train; nor how to assign with exactitude the proper proportion of administrative expenses to each package; nor even how to distribute track expenses between the comparatively light, fast-moving passenger trains and the heavy, slow-moving freight trains. Even if ascertainable, this cost of service would be perpetually oscillating. In this country tonnage is generally lighter in the summer than in the fall, and the consequent less advantageous use of equipment—lighter train-loads, and so forth—means greater cost per ton-mile. Hence, to observe strictly a cost basis, summer rates would have to be higher than fall rates. The establishment of rates on such a basis would by no means do away with the present wide differences in rates. The stream of traffic between the two centers, Chicago and New York, for instance, flows eastward. This entails the returning of large numbers of cars even if empty. The cost of hauling them fully or partly loaded with freight will not be greatly above that of hauling them empty. The cost to the railways of hauling that freight westward is something very different from the eastward cost; and if the basis of actual cost is to be observed, the rate for the former service will be much less than for the latter.

A third basis of railway rates has sometimes been suggested—namely, that they should be fixed in uniform relation to the value of the freight to the shipper. To a degree the present system of freight charges does

this, though also taking into account other factors. An unmodified value basis would carry a ton of coal 50 miles or 500 miles for the same charge, and would resemble a tax. If it were so applied, it would establish the so-called "postage stamp" principle, and, within the territorial limits of its operation, would bring about the annihilation of space (though not of time), regarded by some as the apotheosis of railway transportation. There is little possibility that such a plan will ever assume practical importance, notwithstanding the partial application of the principle in the case of "group" or "blanket" rates.

It is conceivably possible to arrange a classification of commodities so grouped that an appropriate percentage of value could be obtained from a consignment of freight, whether it were a ton of coal or a bale of silk, but the amount of tax incident upon any particular consignment would only by accident bear any relation to the extent of the service performed. Such a system of rate taxation would assuredly tend to concentrate the trade of the country—and consequently, to no small extent, its population—in the seaboard cities, since dealers, receiving import shipments, could handle from the seaboard to any interior point at the expense of a single tax, whereas inland jobbing points would have to make reshipment, and hence would be taxed twice on their imported freight. The political and economic results of this seaboard congestion would be unfortunate. Such a tariff would stimulate extremely long-distance traffic; on the other hand, short-distance traffic would be penalized with higher charges. How-

ever, it is not worth our while to spend time on tracing out the possible results of a merely theoretical basis of railway charges.

Not one of the above theories, standing by itself, is free from serious defect. Yet each contains an element which it would seem desirable to have included among the factors affecting the railway rate, and the conclusion is inevitable that the correct theory of rate-making is one that takes into consideration all of these factors—distance, cost of service, and value of shipment (and, to a certain extent, the value to the shipper of the transportation service performed for him). No fixed relative value can be attached to any factor; the importance of its influence upon the rate must accord with the demands of any particular situation, and may be the same as, greater than, or less than its importance under any other conditions. This is really what practical rate-making endeavors to do, and all that is implied in the much-misunderstood principle of "charging what the traffic will bear."

Many people still regard such a basis of rates as pure piracy, justifying the exaction of unreasonable prices for transportation from the users of the same. Even a railway with sovereign powers over its territory might find it advisable to charge a really low rate for its services. A large volume of business at a low rate of profit may be far preferable to a small volume at a high rate. Monopoly, even in its most absolute form, does not necessarily mean the imposition of the highest charges at which any business can be done, but those charges which are likely to bring in the maximum net

profit. Like every other commercial undertaking, this is what the railways are striving after; and so long as a decrease of charge wlll stimulate and increase business sufficiently to add to the net profit, so long will railways continue to lower their rates, as a matter of pure self-interest. This is further assured by the presence of rivalry among the railways themselves, and by the powerful influence of water competition.

It will be understood that the statement we have made is true as a general proposition and in the long run; but every rule has its exceptions, and there can be no doubt but that, at times, railways have maintained some of their rates, if not at the maximum under which any traffic could move, certainly at a level high enough to retard the development of an industry. Traffic and executive officials are human, and, accordingly, like the rest of us, are liable to misread their own interests. There has been more than one case where a railway has maintained a rate on a certain commodity which permitted but comparatively small shipments and retarded the development of the industry, until the introduction of other rail competition—by the construction of another line, for instance—has forced the rate down, with marvelous results in the growth of that traffic, and with corresponding benefit to the laggard road and its rival. But such conditions as this must be regarded as more or less exceptional. Though hackneyed by frequent use, it is worth recalling that "charging what the traffic will bear" means equally well "not charging what the traffic will not bear." Its interpretation as charging *all* that the traffic can bear irrespective of

the conditions of present and future development, is unjustifiable. Mr. W. M. Acworth, an English writer on railway economics, says:

> Translated into railway language the principle means this: the total railway revenue is made up of rates which, in the case of traffic unable to bear a high rate, are so low as to cover hardly more than actual out-of-pocket expenses; which, in the case of medium-class traffic, cover both out-of-pocket expenses and a proportionate part of the unapportioned cost; and which finally, in the case of high-class traffic, after covering that traffic's own out-of-pocket expenses, leaves a large and disproportionate surplus available as a contribution toward the unapportioned expenses of the low-class traffic, which such traffic itself could not afford to bear.

Of course, such a basis of rate-making removes all mathematical tests as to the propriety of a rate, and as a result discriminations, and so forth, are apt to appear. But all discriminations are not necessarily improper. The discrimination, however, should always be one justified, both in nature and in proportion, by the surrounding economic conditions. For example, it is a universally recognized practice, so far as this country is concerned, to grant a lower rate to the man who can ship a carload than to the man who ships in less-than-carload consignments. It may be that the difference between some existing carload and less-than-carload rates is unnecessarily large; but, however that may be, it is much less expensive for a railway company to handle loaded cars than to have to handle every consignment of freight through its freight-houses, and the convenience to the railway is often worth a considerable reduction from the less-than-carload rate. Just

as there is a justification for the lower level of carload rates, so it may easily be conceived that the shipper who is prepared to ship by train-load is also entitled to further consideration. One can well go farther and say that a still lower charge for transportation might be reasonably granted to the train-load shipper if he were prepared to guarantee regular traffic to the railway handling his freight—a train once a week, for instance. Under each of these conditions there would be a convenience to the railway, resulting in economy of operation and making a lower rate equally as profitable to it as a higher rate under conditions imposing more responsibility and more work.

Of all methods of discrimination the rebate has of late years received most attention. The writer has nothing to say in defense of the secret rebates to which traffic men have been driven in their too eager desire to secure business for their respective roads as against competitive roads. But the rebate that is granted to shippers on condition of consigning a certain amount of freight per week or per month is harmless to the public interests so long as it is an open proposition able to be secured by all who can fulfil the conditions.

More complex than discriminations between individuals are discriminations between places. Every locality will fight to the last for advantages over its competing rivals; and, with this problem of conflicting interests before them, it would be a surprising thing, if the railways could avoid errors of judgment. Injustices have happened under the *laissez-faire* policy of railway tariff-making, but many of the discriminations

arising from that policy have helped industry and manufacture to develop with a rapidity that has been equaled nowhere else. If it had not been for discriminations in favor of the grain of the West, this country could never have acquired the predominance in the grain market upon which it has been able to build so much of its manufacturing prosperity. If freight rates to Chicago had been placed in proportion to freight rates to Albany, there would have been very little Chicago today; if St. Louis had not received the benefits of discrimination in the shape of a differential under Chicago, it could hardly have attained its present prosperity; and the same may be said of a number of other thriving cities in the West and South. Without the development of these entrepôts of trade, and centers of culture and civilization, the economic and social condition of the interior states of this country would be today half a century at least behind what it is.

ORGANIZATION OF THE OPERATING DEPARTMENT OF RAILROADS

R. H. AISHTON, GENERAL MANAGER, CHICAGO & NORTH-WESTERN RAILWAY

The organization of the Operating Departments of railways differs in some respects, but, in the main particulars, has a certain uniformity. Each organization has invariably been developed by a species of evolution, just as the large railway systems of today, with their eight, ten, and even fifteen thousand miles of road under one management, have been evolved by the consolidation and amalgamation of a large number of individual lines, each with its own separate organization.

The line of railroad with which I am connected—the Chicago & North-Western—may be taken as an example. I have a little pamphlet, entitled *Yesterday and Today,* containing a brief history of the road, in which I find that, starting in 1847, with the construction of the first mile of the Galena & Chicago Union Railroad, chartered and built westward from Chicago, we read, in successive order, of the following lines: The Madison & Beloit; the Rock River Valley; the Chicago, St. Paul & Fond du Lac; the Kenosha, Rockford & Rock Island; the Chicago, Iowa & Nebraska; the Cedar Rapids & Missouri River; the Milwaukee & Chicago Union & St. Paul; the Sioux City & Pacific; the Fremont, Elkhorn & Missouri Valley—all of them separate organi-

zations, started and built originally by local capital and to serve local interests, each with its own organization and set of officers.

The organization of these roads primarily consisted of a principal officer, who was usually the representative of the financial interests connected with the road. Under him was a Manager or Superintendent, and evidence is not wanting that he was the whole Operating Department, so far as the organization was concerned. He looked after the track, bridges, etc.; purchased all the supplies, audited the accounts, paid the taxes, built the cars, repaired the locomotives, acted as train dispatcher when the telegraph service was first instituted; and, in general, was the "whole thing."

In October, 1864, a consolidation of the various lines took place, whereby the Chicago & North-Western Railroad came into being. About that time the true organization or evolution of the Operating Department began, and it became necessary to have a certain authority who should bring uniformity of practice into the administration of the road. There being a number of superintendents for the small portions of the road, the most natural thing was to create a General Superintendent, responsible to the President. His duties were naturally scattered over a wide ground, and this led to the appointment of an expert in charge of the engines, motive power, and cars, termed a Master Mechanic or Superintendent of Motive Power. The purchases for the road having attained large proportions, it next became necessary to appoint a Purchasing Agent in charge of all these things. Long before this, how-

ever, it had become necessary to take the traffic entirely out of the hands of the General Superintendent, and to create a special department for this, reporting directly to the President. The maintenance of track and bridges, and the movement of trains, by this time had become so important that the General Superintendent was overburdened; therefore a General Manager, usually an expert in these matters, was appointed, to whom heads of the various departments would report, and through him to the President. So much for past history.

As indicating the scope of the system and the responsibilities that are placed with the operating men, it may be of interest to note that in 1857 the old Chicago & Galena Union Railroad, which is now the Chicago & North-Western, had 260 miles of road, and that the total number of men employed was 1,904. In the fall of 1857 there was a panic, and in January, 1858, the road had discharged all of its force except 722 men. Today there is in the employ of the Chicago & North-Western an army of 28,000 men, for the faithful performance of whose duties the Operating Department is responsible. The road comprises 7,408 miles of track, and has 1,307 engines, 1,200 passenger-cars, and 52,-500 freight-cars; and it is the particular province of the Operating Department to see that these vast powers are worked with a view to securing results for the owners.

The present organization of this vast system can best be made intelligible in diagrammatic form.

ORGANIZATION OF THE OPERATING DEPARTMENT OF THE CHICAGO & NORTH-WESTERN RAILROAD

- General Manager
  - General Superintendent
    - Division Superintendent
      - Train Master
        - Conductors and Brakemen
        - Yardmasters and Switchmen
        - Engineers and Firemen on Road
      - Train Dispatcher
        - Agents and Operators
      - Road Master
        - Section Men, Extra Gangs
        - Watchmen
      - Division Engineers on Maintenance
        - Water Supply Men
        - Bridges and Buildings Men
    - Signal Engineer
      - Signal Supervisors
        - Interlocking Operators, Lampmen, Maintainers
    - Car Service Agent
  - Superintendent of Motive Power
    - Master Mechanics
      - Shop Foremen, Round House Foremen
      - Road Foremen, Engineers and Firemen (at terminals)
  - Superintendent of Car Department
    - Repairmen and Inspectors
    - Cleaners and Oilers
    - Car-Builders and Painters
  - Purchasing Agent
    - Inspectors, Fuel Agent, Scalemen
  - Chief Engineer on Maintenance
    - Division Engineers on Maintenance
  - Dining-Car Department
    - Conductors, Cooks, and Waiters
  - Superintendent of Telegraph
    - Telegraph, Telephone, and Electric Light Men
  - Engineer of Tests
    - Material Inspectors, Test Force
  - Fire Inspector
  - Claim Department
    - Adjusters

The General Manager stands at the head of the Department. His aids are the General Superintendent, the Superintendent of Motive Power, the Superintendent of the Car Department, the Purchasing Agent, the Chief Engineer (on certain classes of work), and, in succession, the heads of the Dining-Car, Telegraph, Testing, Inspection, and Claim Departments; each of whom reports to his superior officer. Reporting to the General Superintendent are the Division Superintendent, the Signal Engineer, and the Car Service Agent. Reporting to the Division Superintendent are the Train Master, on all matters pertaining to employees engaged in train and yard service; the Train Dispatcher, in charge of the agents and operators; the Road Master, in charge of the men employed on track and maintenance and repairs; and the Division Engineers, on matters pertaining to water supply and bridges and buildings. The development of signal systems in the last few years has brought another officer into the field, as an aid to the General Superintendent, namely, the Signal Engineer, who has charge of all the men installing, operating, and maintaining the signals. For the proper distribution and use of the equipment of the company, an officer, termed the Car Service Agent, is injected into the organization, reporting directly to the General Superintendent, and acting under his instructions.

Next in relative importance to the General Superintendent, on the staff of the General Manager, is the Superintendent of Motive Power. The diagram fully explains the scope of his duties, and much of the effi-

ciency and smoothness with which the service is conducted is due to the efficiency of this department. Without locomotives in first-class condition, ready for duty at all times and in abundant number, the service rendered by the corporation, and the results to that corporation, will be disappointing.

The duties and work of the other officers are clearly outlined in the diagram, and need no explanation.

In this very brief outline I have endeavored to make clear the scheme of organization, the duties of the various officers and employees, the relations between them, and the various channels by which the General Manager retains his control and knowledge of the situation. Lord Nelson, at the battle of Trafalgar, said to the men of his navy: "England expects every man to do his duty." The province of the Operating Department is not only to say this, but also to outline definitely beforehand to every man in the service just in what his duty consists, and then to see that every man actually does his duty, by day and night, in foul weather as well as in fair.

THE PURCHASING AGENT

E. V. DEXTER, PURCHASING AGENT, CHICAGO & ALTON RAILROAD

In presenting the subject of the Purchasing Agent and the Purchasing Department, I shall endeavor to give a general and connected idea of that branch of railway work. There is, of course, much detail, such as actual figures, kinds of office forms used, and the like, that cannot well be fully discussed and explained in the time at my command.

The first thing to be considered is the origin of the office of the Purchasing Agent—how and why it became necessary. It may be said to be one of the newer offices, when compared with those of the Superintendent and of the Master Mechanic. By process of evolution, it has grown up into a department of itself. When I say "evolution," I mean that its necessity became apparent with the same onward force that has resulted, and is resulting, in the consolidating and intensifying of railway business generally.

It is not so very long ago that a separate department of purchases was not considered necessary in many instances. The small roads in the early days secured their supplies and distributed them through the Superintendent's or General Manager's office. In such cases there was no necessity for a Purchasing Agent. This is still true today of certain railway companies of small mileage and limited business, where a trusted

clerk in the Superintendent's or General Manager's office looks after all the detail work, and places orders as he is instructed. With increasing consolidation, and the forming of the present-day railway systems, these purchasing duties had to be specialized and put in charge of one officer, who devotes his whole time to them.

I have used the word "specialized;" and, at first thought, it may appear necessary that the Purchasing Agent should have, as his chief qualification, a technical and expert knowledge of the hundreds of classes of materials which he is called upon to buy; but this is impracticable. For instance, to know to a nicety the limits of stress on a steel bridge girder comes rather within the province of the Chief Engineer. In a general way, the qualifications that count of most importance are integrity, good business sense, sound and quick judgment, and sufficient railroad experience to handle the business of the office with dispatch.

The special and expert work of the Purchasing Agent lies in his constant watchfulness and study of markets and prices, in order to be able to take advantage of market conditions, in a measure to forecast future conditions, and to act accordingly. A good way to keep informed is to read the daily papers as well as the commercial periodicals. Dun's and Bradstreet's commercial agencies give reviews of business conditions in the daily papers. The trade journals, like the *Iron Age,* the *Commercial Bulletin* and various others, give the trend of the markets, granting always the exercise of personal judgment in the reading. There

are certain lines of material, like iron and steel, that have a way of indicating general business conditions. In fact, it seems that other lines of business follow along; and when the slump or rise comes in these particular materials, one may expect to see other materials affected in like manner. Another way in which the Purchasing Agent cannot help absorbing much information of this kind is by frequently seeing and talking to the representatives of the trade. These men, many of them, are as well posted in business affairs pertaining to railway supplies as can be found, and are most willing, of course, to talk prices and to discuss the outlook. The element of personal judgment comes in here again, and the Purchasing Agent soon learns to get at the facts.

Previous experience in railway work, leading up to the position of Purchasing Agent, is of considerable advantage, and gives him much more confidence in his frequent reports to, and correspondence and conferences with, other officers of the road, and, in fact, in all his negotiations. The knowledge of how freight is handled assists in getting the material to its destination after it is ordered—no small part of the work. A general idea of railway accounts, and an understanding of railway office detail, are collectively a valuable qualification, though not the most important.

The office of the Purchasing Agent is not elective, like that of the Treasurer or the Secretary, but he is appointed either by the President or the General Manager, or by the Vice-President and the General Manager. The Purchasing Agent becomes one of the

general officers of the road, and reports, and is acountable, to the officer appointing him.

The Purchasing Agent's office is sometimes classified in the Operating Department, but more often and properly becomes a department by itself, as the work is distinctly different from that of other departments. The Purchasing Agent does not have any direct authority as to how the road shall be operated; he cannot say what method shall be followed in securing the traffic of the road, either passenger or freight; he has no authority in financial policies, or to formulate methods for the accounting of the road's receipts and disbursements; but he has authority over the material required to operate the road—not how or where it is to be used after he has secured it, but in seeing that his company has the right standard of material for its needs, and that it is obtained at a satisfactory cost. This is really the heart of the Purchasing Agent's work. His advice is asked, and cost reports are called for, in the case of expenditure for improvements and additions. He is in a position to know the favorable time when the purchase of material for this extra work and improvement should be made, and in this way can render valuable service.

The scope of the Purchasing Department may be divided into three heads: (1) procuring supplies—including the purchase and, after purchase, the delivery of the material to its destination; (2) the conservation of supplies, or store stock; (3) the sale of old material.

Beginning with the first head, procuring supplies, I shall first give a general outline of the Purchasing Agent's force. This includes the men in the office and

those in the field. The office force and office detail are placed in charge of an assistant or chief clerk, who has under him a sufficient number of order clerks, voucher clerks, and invoice clerks to turn out the work promptly and satisfactorily, subject to the supervision and direction of the Purchasing Agent. The modern railway system has its Fuel Agent, Stationer, Cross-Tie Inspectors, and General Storekeeper—all, as a rule, within the Purchasing Department and reporting to the Purchasing Agent.

It may be noted here that fuel is the largest single item of material expense; and, to give some idea of quantities and cost, I may mention that the railway with which I am connected, operating about a thousand miles of road, uses over half a million tons of coal, at an annual cost of about $600,000. While these are large figures, they are comparatively small when compared with the consumption and cost on the larger railway systems. Hence it is not surprising that the work of the Purchasing Agent is divided, and so arranged that all of these important matters may receive the proper attention. The Fuel Agent's duties are of no small importance, as he is held responsible for the proper kinds of fuel and the proper amount. His negotiations are carried on directly with the mine-owners and operators, and he is expected to keep himself informed concerning the situation in the coal markets. If there are actual or threatened strikes in the coal-fields from which the railway company draws its fuel supplies, he must take such action as will protect his road in the event of a shortage. In the same general way, the

Tie Inspector, the Stationer, and the Storekeeper are looked to for results of economy and good service. I have not named all of the officers whom I have designated as the men in the field: their number and duties vary with the extent and business of the railway.

Now, the question may possibly be raised here: How does the Purchasing Agent know how much and what kind of material to buy? Whence comes his information? The basis on which he works is the requisition. Requisitions show the quantity and kind of material, what it is to be used for, and how soon it is wanted. The departments using the material, as shown on the various requisitions, are the Motive Power, Maintenance of Way, Signal, Transportation, and Commissary or Dining-Car, and the requisitions are compiled under the direction and approval of the heads of these departments. These requisitions, with few exceptions, are forwarded through the office of the General Storekeeper, and are then sent to the General Manager, sometimes to both the General Manager and the President, for approval, before they reach the Purchasing Department.

There are, however, certain exceptions to this general rule. There are cases of emergency where material is ordered by telegraph. In such cases the requisitions covering the telegraphic orders are received later, with a notation to that effect. A particular instance of this occurred during the Missouri and Mississippi river floods in June, 1903, when large quantities of piling and timber were ordered by telegraph to insure the promptest possible handling of the orders. In

an emergency of this kind the Purchasing Agent is expected personally to see that the cars for the material are placed promptly, and the material loaded and shipped without delay. In the instance just cited much of the material was on the way to its destination twelve hours after the order to purchase it had been received. Any delays in such cases are very apt to mean additional loss, and of necessity such emergency supplies cannot wait on the regular requisition procedure. I might mention that at that time a quantity of gunny sacks, filled with sand, were secured and dispatched with all haste to the scene of trouble, for the purpose of bolstering up the caving embankments.

As explained above, the requisitions, after having received the proper approval, next come to the Purchasing Agent's office for his action. The Purchasing Agent has on hand a list of prices for practically all material that he is called upon to buy, subject to continual market changes. Such of the material as has been secured on contracts made by the Purchasing Agent for a period of time may be ordered at once without any further preliminaries. Material not contracted for is listed and sent to supply concerns with the request that they make their bids. In this way, by the operation of competition, the lowest prices are secured consistent with the quality and grade of material specified on the request for bids. When the bids are received, the Purchasing Agent is ready to place the order; but considerable judgment is required in selecting the right bid. As a general proposition, the lowest price usually takes the order. But, besides the price, other things

must be considered, as, e. g., whether or not the bidder can deliver the material within the required time, or whether from his past experience the Purchasing Agent may be sure that the lowest price quoted covers the quality and kind of material wanted. These negotiations are frequently carried on verbally, as well as by correspondence. At times a better arrangement can be made verbally. Throughout these negotiations it is essential that the business is handled very promptly, and that no effort is spared to cover all points before the order is finally placed.

After this somewhat brief explanation of how the fuel supply is handled, something may now be said regarding quality. The Fuel Agent may or may not have one or more fuel inspectors reporting to his office, whose duties keep them out on the road and at the mines. By this system of inspection the quality of the fuel is maintained at standard. The method of inspection varies with the different railways, and is governed or limited by the extent of the purchases. In some cases the fuel inspector is responsible to the Superintendent of Motive Power, while in other cases the Fuel Agent, or the official buying the fuel, is held responsible; but, in any event, the Purchasing Department is finally accountable for the proper standard of fuel. In much the same way, cross-ties and other timbers are inspected, and the quality, conforming to standard specifications, is maintained. The cross-tie inspectors, as a rule, report directly to the Purchasing Agent.

Regarding the question of quality and inspection of the thousand and one other materials, it may not be

unreasonable to suspect that the Purchasing Agent is often quite at sea when it comes to knowing whether or not such materials conform to the standard of quality required. It must, however, be remembered that in every railway system all the employees, from the highest to the lowest, bear some relation to one another—a relationship governed by what is known as "the good of the service." Hence the Purchasing Agent is protected, as it were, by as many inspectors of material as there are users of it. It is both a written and an unwritten rule that, where material is received that is inferior, or does not conform to standard specifications, it must be reported at once, or rejected if necessary. This information always comes to the Purchasing Agent very promptly, and sometimes with more than ordinary emphasis. The Purchasing Agent has thus a complete check on the quality of the material; and, where the specifications have not been complied with, the supplying firms, whether intentionally or unintentionally offending, are the losers. Owing to the efficient protection of this system, such occasions are, however, comparatively rare.

Another means of guarding against inferior quality is the system of printed specifications, referred to above. For instance: The Motive Power Department uses quantities of various materials, and, in order to secure a standard of quality, specifications are prepared by experts in this department, defining exactly the grade of material and the tests it must stand. These specifications, as they are prepared, are printed, the Purchasing Agent keeping a supply in his office. In the same

way the Maintenance of Way and the Transportation Departments have their specifications. While these do not cover everything that is bought, as far as they go they furnish a substantial foundation for the Purchasing Agent upon which to base his purchases. When these specifications are used, it is incumbent upon the department needing the material to inspect and test it to see that it is in accordance with the standard requirements. There are yet other means to determine the quality of railway supplies; in which connection may be mentioned the various laboratories operated by independent companies having in their employ expert engineers to inspect, test, and analyze all material entering into railway work. Practically all steel rail is inspected, tested and analyzed by these independent companies. Some of the larger railway systems have found it economical to maintain their own testing laboratories, in charge of the Engineer of Tests.

The mere purchase of the material does not complete the work. When the orders are placed and accepted, they must be followed up to see that the material meets with no transportation or shipping delays. What are known as "tracers," both written and telegraphic, must be sent out, in order to follow and hasten shipments of material that has been delayed, or which is hard to secure after it has been ordered. There is perhaps no limit to the effort which a Purchasing Agent may expend in this direction.

As to the kind of material that should be contracted for, there is no rule other than the conditions of the markets and the amount required of a given kind. It is

always safe to contract for locomotive fuel, as there is no telling what may happen to set one's plans at naught, unless one is protected. The supply of cross-ties should likewise be looked after, as well as such other materials as cement, cast-iron pipe, etc., whenever it is expected that a large quantity will be used.

To sum up, the question of contracts is one generally regulated by the Purchasing Agent's judgment.

The Stores Department, or Store Stock, is usually presided over by a General Storekeeper, reporting, as a rule, to the Purchasing Agent, but sometimes to the Superintendent of Motive Power. With few exceptions, the record of all material purchased, other than that properly belonging to the Stationery and Commissary Store Stocks, as well as the record of the requisitions discussed above, is kept by the General Storekeeper. While all this material is not delivered direct to the Storehouse, and much of it is consigned to points on the line where it is to be used, the Storekeeper is expected to have a complete record of the kind of material, quantity, cost, and by what department used. There are also many classes of material, such as lumber, small hardware, etc., that must be kept on hand to be issued to various departments—materials that cannot well be bought in the small quantities called for daily. This stock, which we might call "running supplies," is replenished as often as necessary by the Purchasing Agent, on approved requisitions received from the Storekeeper. The Storekeeper in turn issues these supplies from the Storehouse on requisitions known as Store Stock requisitions, received by him from foremen

of shop departments and agents, bearing the approval of the proper officials. With his force of clerks, the Storekeeper is expected to know at all times the condition of his stock. Besides his system of accounts and checks to keep track of this, there is a semi-annual inventory by actual count and measure. It is a test of efficiency for the Storekeeper to keep down his stock to the lowest practical working point, in order not to have more money than necessary tied up in material. For the purpose of facilitating the issue of these stores to all points on the road, there are outlying smaller stores, taken care of by local storekeepers or clerks, who are accountable to the General Storekeeper in all matters pertaining to their stocks.

In addition to this General Store Stock, there is another important stock, known as the Stationery Store Stock, where a supply of all the numerous blank forms and other stationery is kept, to be issued by the Stationer promptly on receipt in his office of the monthly requisition from the General, Division, and Station Agents' Offices. These requisitions, as a rule, are supervised and approved by the Traveling Auditors. The form and nature of the blanks are usually arranged through a Blank Form Committee or by the General Manager, and contracts are made by the Purchasing Department providing for the necessary supply. There is, in addition to these blank forms, considerable printing that is not carried in stock, such as general office orders, advertising matter, freight tariffs, and the like.

Another stock, known as the Commissary, and in charge of the Superintendent of Dining-Cars, is han-

dled in much the same way. In the case of each of these three stocks there is a monthly balance taken as a check on the amount of supplies. Although it is not taken by actual count and measure like the semi-annual inventories, yet it is very important and serves to keep the book records up to date and correct.

One more matter remains to be spoken of, namely, the sale of old, worn-out material. This finds a ready market in nearly every part of the country. Old rails, serviceable for relaying purposes, bring almost as much as new rails, and are easily disposed of. There are several other kinds of salable salvage, such as empty oil barrels, scrap paper, scrap linen, brass foundry ashes, and many others too numerous to mention. This end of the work includes also the sale of old cars, engines, machinery, etc., and requires as close attention as the purchase of new supplies. Scrap sales amounting to $10,000 per month are not a high average for a railway of moderate size. The second-hand material dealers are as shrewd a business class as the Purchasing Agent meets with.

BALLAST

A. S. BALDWIN, CHIEF ENGINEER, ILLINOIS CENTRAL RAILROAD

The term "ballast" in railroad parlance is applied to any material that is used between the cross-ties, or sleepers, of the track, and the surface, or subgrade, of the roadbed as constructed. Its function is to maintain the track and to protect the surface of the roadbed. The word "ballast" is defined in the *Manual of Recommended Practice of the American Railway Engineering and Maintenance of Way Association* as "selected material placed on the roadbed for the purpose of holding the track in line and surface." This fitly describes it.

The primitive method of ballasting, or rather of surfacing, the track was to use the material of which the roadbed was composed; but it was soon found that many materials furnished and maintained a better surface than the clay or earth of which the roadbeds were most generally formed. These better materials were transported from their natural location and interposed between the cross-ties and the subgrade at other places, thereby becoming, and being called most appropriately, "ballast." It is still common to find tracks of railroads, which have light traffic and slow speeds, surfaced on dirt. Such tracks are sometimes spoken of as having "dirt ballast;" but the name is a misnomer, as the word is correctly applied only to the material interposed between the cross-ties and the roadbed.

It will be proper to consider, first, what the requirements of a material are in order that it may constitute a perfect ballast; and, second, the characteristics of the materials used as ballast, and their adaptability for such use.

In order to meet the requirements of a perfect ballast, a material should be hard and durable, capable of resisting the destructive effects of tamping and the disintegrating influences of the atmosphere.

It should be easily handled and capable of ready adjustment. The roadbed is subject to settlement, and is liable to be eroded, changed, and encroached upon in many ways; but the surface and line of the track must be maintained at all times. Consequently, it is of great importance that ballast should be capable of being easily adjustable to such changed conditions, on short notice.

It should be sharp; that is, the projections from its surface should be acute and capable of engaging the cross-ties, so as to prevent lateral or longitudinal motion.

It should be a "free" material, so that the water that falls upon it may pass off readily, since, if held, it will heave the track when frozen, or soften the roadbed under other conditions.

It should have no chemical properties that will cause it to be destructive to the cross-ties, whether they are of wood or metal.

It should be capable of being obtained in large quantities and at reasonable cost.

There is, of course, no material that can fulfil all of these requirements; they are given only by way of

affording a basis of comparison between the various materials that are in use as ballast. Of these materials the following, named approximately in the order of excellence or availability, will be considered: (1) broken stone; (2) gravel; (3) furnace slag; (4) cinders; (5) burnt clay; (6) sand; (7) chert; (8) chats.

1. *Broken stone.*—The material that probably most nearly fulfils the requirements of a perfect ballast is crushed or broken granite, gneiss, or trap rock. Following it closely is broken limestone, some limestone being equal in its properties, for this purpose, to granite. It is but rarely that sandstone of sufficiently hard and durable quality is found to stand being broken successfully into ballast.

Broken-stone ballast was originally obtained by taking the rock from the quarries in stones of a size that could be readily handled by one man. These stones were distributed along the track, and then broken into spalls by napping hammers. The hammers weighed about two pounds each, and were used with long handles, so that a man in standing position could break the stones, which finally were reduced to small sizes by "stone-crackers." This process made excellent ballast; the cubes were sharp, and there was but little waste. The final breaking, which was done between the ties and on the shoulders, made the mass solid and compact. It is still claimed by many old track-men that no track so well maintains its line and surface as the one put up in this way—i. e., which has had the stone broken into it after it was surfaced. The process was too slow, however, the quantities required too great, and labor

i__ scarce, to permit of the continuance of such methods; hence, rock-crushers were introduced. These have gone through various processes of evolution, and are now manufactured in very large sizes, single crushers being made capable of producing 2,000 tons of crushed stone per day. In some plants several large crushers are sometimes mounted so as to take the stone as it first comes from the quarries, deliver it into screens which sort it into various sizes, and, by means of conveyors, return any stone of too large size that is carried through, to a smaller crusher, which in turn recrushes and delivers it.

The size of stone required for ballast varies somewhat under different specifications. The size most generally required at first was a stone that would pass in any direction through a two-and-a-half-inch ring. Nowadays engineers are generally requiring a somewhat smaller stone, sizes that will pass through a two-inch or one-and-three-quarter-inch ring being frequently specified. A beautiful and efficient ballast is formed by eliminating all stones in excess of two inches and under three-quarters of an inch. Where stone ballast of too small size is used, it becomes readily filled with dirt, which prevents it from being "forked" clean.

A great mistake, in the writer's judgment, is frequently made by using broken-stone ballast on a new roadbed. Where the roadbed is freshly formed of earth, the best and most economical results are obtained by first using a material of a bonding nature, which will solidify the top surface of the grade. There is, of course, no bond to broken stone; as a result, when

first used on a new roadbed, it sinks into the surface, particularly where the latter is composed of soft or moist material, becomes filled with mud, and is ruined. As, on a new road, frequent ditching and banking are required, the shoulders of the ballast are likewise liable to become filled with dirt. In the writer's opinion, one of the best materials for use on a new roadbed is gravel of a strongly bonding nature, as it forms a solid and compact surface on top of the grade for sustaining the stone ballast when used. Where this cannot be had, the screenings from rock-crushers form an excellent substitute. Even free gravel, sand, or cinders, used before the stone ballast, effect a great economy and afford greater facility for quick manipulation.

Broken stone forms an excellent ballast where the track is subject to water-wash of any kind. Where stone is costly and difficult to obtain, track subject to wash, and surfaced on sand or free gravel, has sometimes been protected from the wash by a top dressing or veneer of stone.

Stone is, ordinarily, more expensive in first cost, and in cost of maintenance, than other ballast, but affords a more durable roadbed, and one that is freer from dust—the latter feature affording a great attraction to the traveling public. The cost of tie-renewals is likewise higher with stone than with other kinds of ballast; but, on account of the facilities afforded for drainage, the life of ties is longer, and the encroachment of vegetation is resisted.

The hardest of stone ballast is gradually disintegrated by the effects of tamping. An examination of

the stone after it has been tamped under the ties shows that most of the cubes have been crushed by the process. It is likewise wasted from the sides in cleaning the roadbed and in cutting the sod line. Consequently renewals, to a greater or less extent, are always going on.

2. *Gravel.*—Of the kinds of gravel that are used for ballast it may be well said that their name is legion. It is more liberally provided by nature, of a quality fitted for ballast in its natural condition, than any other material, and the best of it can hardly be surpassed in usefulness and adaptability for the purpose. It is found in many parts of the country in large beds, from which it can be lifted by steam shovels in great quantities, and loaded on the cars at a cost of but a few cents per cubic yard. In some places it is dredged from river bottoms, and in others, where mixed with earth or clay and bowlders of too large size, it is made serviceable by washing or crushing.

In the writer's judgment, the best gravel ballast is one that is entirely free from bonding material, has stones with a maximum size of about that of a walnut, and has in its composition a sufficient amount of sand to hold the particles together. Where gravel has neither sand nor bonding material in its composition, it is too loose and is easily jarred from under the track.

On some railroads in the East a very high quality of track is maintained by placing upon the subgrade, before any ballast is used, about twelve inches of coarse spalls, an equal depth of gravel being provided on top of this. This gives, so far as drainage is concerned,

almost an ideal condition, as the water is drained away from the ballast almost as rapidly as it falls, and the base is protected by the spalls from wash. An excellent feature of such an arrangement is the added length of life of the cross-ties, due to the fact that water is drained away from them immediately.

A most excellent ballast is obtained in some places in this country by dredging the sand and gravel from the river bottoms, passing it, in the process, over screens which eliminate the large stones, leaving only such proportion of sand—ordinarily twenty to thirty per cent.—as will afford the best results. Such a plant is now working for the Yazoo & Mississippi Valley Railroad below Memphis, and at other points on the Mississippi River. Some of them have a capacity of several thousand yards per day.

At some places in the South, and probably elsewhere, gravel of a very highly bonding property is found, notably the "Paducah" gravel in Kentucky, the "Tishomingo" gravel in Tennessee, what is known as "novaculite" in Illinois and Missouri, and "chert" in Alabama and other states; the last two, however, not properly being included with gravel, although having the same properties, so far as adaptability for ballast is concerned. These materials generally form a very hard, compact, and inelastic roadbed. They cannot, as a rule, be dressed with a shoulder, as a basin is thereby formed around the tie, which becomes filled with water in rainy weather and produces churning. They promote the growth of vegetation, necessitating frequent weeding, but form a durable roadbed and, as before

stated, a most admirable foundation for stone ballast.

The objections to most gravels for ballast are that they are dusty, that they are subject to being washed from under the ties during heavy rains, and that they promote the growth of vegetation. As an offset to these disadvantages, however, it is ordinarily the most economical material that can be obtained for ballast, it is easily handled and transported, and it affords an inelastic and smooth track. Tie-renewals can be made much more cheaply in gravel than in stone, and, when it is "free," the life of the ties is as long as with stone ballast. It is probable that more track in this country is surfaced with gravel than with any other one material.

The disagreeableness of dust for the traveling public has been referred to, but it is objectionable also because it has a marked effect on the machinery and rolling-stock. The tires of locomotives, the tread of wheels, and the journals are all much more rapidly worn on a dusty roadbed than on one that is free from dust.

3. *Furnace slag.*—Slag, as is well known, is the waste material from blast furnaces. It is sometimes allowed to run out into beds from the cinder notch; water is thrown on it, and when cooled sufficiently, it is loaded into cars. Ordinarily, however, it is run from the furnace, in a molten condition, into cars lined with fire-brick, and allowed to run from these cars while melted. The melted material forms successive strata, which break up in cubes from half an inch to several inches in diameter, constituting then what is known as "hot pot slag"—an excellent ballast. It is extremely sharp and very brittle. While generally harder than

stone at first, its brittleness causes it to crush under tamping, and at times it slacks, probably on account of excess of lime. It has more bonding qualities than broken stone, solidifying under traffic to a very considerable extent, for which reason it is better for use on new roadbeds. As a first coating, it forms an admirable foundation for broken stone.

There are methods of granulating the slag, or otherwise preparing it especially for ballast. These are, however, but little used in this country. There are said to be certain varieties of slag which cause decay to set in very quickly in the cross-ties. As a general thing, however, this does not seem to be the case. Slag is sometimes loaded on the cars by the furnace companies in order to get rid of it, under which circumstances it can be obtained very cheaply. With a steam shovel, the material can be loaded directly from piles into the cars at small expense. The cost of maintenance under slag is practically the same as that of rock.

4. *Cinders.*—For many years the value of engine cinders as ballast was not appreciated. The material was wasted, used in filling and leveling off yards, or often given away in order to get rid of it. It constitutes, however, an excellent ballast for certain purposes.

Where the roadbed is wet and muddy, many kinds of ballasts rapidly sink in and are destroyed. Under such conditions, cinders, on account of being light and porous, will sustain the track successfully where nearly all other ballasts fail. They are so light that large quantities can be carried on a car—a great advantage when transported considerable distances. They are

easily and quickly handled, resembling in that respect a fine gravel or sand. Tie-renewals can be made in cinders readily and cheaply, and they are particularly advantageous for use in freezing weather, as, on account of their resistance to moisture, they are not apt to freeze to any very considerable extent, and track surfaced on them can be worked on in cold weather.

Cinders, as ballast, have two serious effects, in that they cause very rapid deterioration and decay of the cross-ties, and have a corrosive effect on the rail. It is not uncommon, in yards where tracks have been surfaced on cinders for a number of years, to find the base of the rail greatly corroded; and the life of cross-ties is much curtailed where they are used. They form, however, an excellent ballast for branch lines, on which traffic is light. Even a few inches of cinders under the ties will make it possible to maintain a remarkably good surface; and, on account of their elasticity, they afford an exceptionally smooth riding-track.

5. *Burnt clay.*—The use of burnt clay as ballast is comparatively modern. The best of it makes a ballast that is inferior to either stone, slag, or first-grade gravel. It came into use, however, on account of the fact that many miles of railroad in some sections of the country were so far from any natural sources of supply for ballast that the cost of transportation was prohibitive; hence, the idea was conceived of burning clay. The raw clay is taken from the ground, arranged in alternative layers with slack coal into large heaps, and fired. After the mass becomes thoroughly burned, it is

allowed to cool gradually, and is then loaded, frequently with steam shovels, into cars for transportation.

Some specimens of burnt clay are found to be extremely hard, but as a rule it is light and unable to withstand, for any great length of time, the action of tamping. It supplies a long-felt want in many localities where there is no natural ballast, and where the cost of transportation for other ballast is too great to be justifiable.

6. *Sand.*—Sand is ordinarily used for ballast only where it is not practicable to obtain any of the materials hitherto discussed. In a dirt roadbed, however, with a sufficient quantity of sand under the ties, a much higher degree of efficiency can be obtained than if the tracks are surfaced on dirt. Where better materials cannot be had, it affords a top dressing for a green roadbed which is a decided improvement over putting a good ballast, particularly stone, immediately on the subgrade.

7. *Chert.*—Chert is decomposed hornstone or flint rock. It occurs, so far as the writer's experience extends, in irregular beds, sometimes of considerable magnitude, and in different sections of the country. In being taken from the bed it breaks up into angular cubes of various sizes, and makes a ballast similar to cemented or bonding gravel, giving an extremely hard and inelastic roadbed. It is necessarily dressed away from the ends of the ties, as it would otherwise hold the water in. It makes a firm and durable top for the roadbed, and affords an excellent foundation for ballast of other descriptions. Chert and novaculite, and similar

materials, are much more suitable for the construction of roadways than for use as ballast, except as a foundation.

8. *Chats.*—Chats are waste or tailings from the ores of zinc and lead. They come in granules of about the size of a pea, and are extremely heavy. They afford a ballast akin to that of fine gravel of similar size, except that they are not so liable to be washed, holding their position in the track more firmly on account of their weight and of their becoming, in a measure, solidified. The use of chats is restricted to the comparatively small area of the country in which the mills are located. By reason of the fact, however, that the process necessitates the use of a large amount of coal, they have been used quite largely by railroad companies, as the cars, in being returned home, can be loaded with chats instead of running empty. Chats are freer from dust than most gravel, and are not favorable to the growth of vegetation.

Before closing, some mention should be made of the screenings from rock ballast. It is now universally customary to screen the stone as it is broken by crushers in the quarries, in order to eliminate the fine material from the stone ballast. These "screenings" are used for various purposes, making sidewalks and fair platforms, where not subject to heavy usage. They are also used in ballasting branch and subsidiary main lines. They form, under the track, a compact and solid mass, bonding to a considerable extent. In the ballasting of new roadbeds, screenings have been found to afford an excellent foundation for rock ballast; in fact, the use

of any bonding material on such roadbeds has been found to work an economy in both the cost and maintenance of any character of free ballast.

The following table gives the average cost per cubic yard of production of ballast in various localities:

	Material	Labor	Haul	Total
Stone........	$0.50–0.60	$0.25–0.35	$0.05–0.25	$0.80– 1.20
Gravel.......	0.06–0.25	0.15–0.25	0.05–0.15	0.26– 0.65

The question of the transportation of ballast is one of considerable importance in the maintenance of a modern railroad. Where it is to be carried very long distances, cars of great capacity are provided and heavy machinery is used, the same rules for economy in operation applying as in handling revenue freight. As an illustration, the Illinois Central Ralroad is today transporting stone from Kentucky, to use on extremely southern lines in Louisiana and Mississippi, where no good natural ballasts occur—an average distance of 500 miles.

Two kinds of cars are employed, the Roger ballast-cars of 100,000 pounds' capacity being used in connection with side-dump cars. The Roger cars can be unloaded with great convenience and economy, being designed to unload such proportion as may be desired either in the center or along the sides of the track. It is customary to get the track as high as possible on the first raise, dump the Roger cars in the center of the track, and follow it up with the side-dump cars. This effects a great saving in the manipulation of the ballast as it is delivered to the roadbed, the side-dump cars being

unloaded with Lidgerwood machines and center plow. When the haul is great, the side-dump cars afford an economy, as compared with Roger ballast-cars, on account of their greater carrying capacity in proportion to the dead weight. The side-dump cars, when used alone, however, involve the necessity of forking or shoveling a portion of the ballast into the center of the track.

Ordinarily 3,000 cubic yards of ballast are required for a mile of track, this providing for twelve inches of ballast under the ties. The amount varies, however, with the depth required, the length of cross-ties used, and the amount of shoulder outside of the ties. For convenience, there is attached a table giving the number of cubic yards required under varying conditions.

It will not be out of place, in closing, to refer to the question of drainage, which is the *sine qua non* in the maintenance of a roadbed. No ballast of any character can be maintained in good shape, nor used effectively in the maintenance of the line and surface of the track, unless ample facility is provided for draining the water away from the track. It has been well said that "water is the worst enemy of the roadbed."

The writer has had experience with what is ordinarily spoken of as "bad bottom;" that is, a roadbed composed of clay or earth lacking consistency and easily attacked by water. On occasions he has come across both cuts and fills, on which the best stone ballast had been placed and replaced for a number of years, in which the stone, mixed with mud, has actually been found to a depth of five to six feet below the cross-ties.

In digging into such embankments, they have been found, in the driest weather, to be thoroughly saturated with water. Under such conditions no roadbed can be effectively maintained with any kind of ballast, the only solution being the provision of a thorough and efficient system of drainage. This is accomplished in many places by subsoil drainage, such as is used on moist farm lands, tile drains being placed below the level of the roadbed so as to keep it in a thoroughly dry and compact condition.

With first-class drainage and a heavy rail, an excellent condition of roadbed can be maintained with even a poor character of ballast; the highest efficiency being reached, of course, where the best of drainage and the best of ballast are combined.

ILLINOIS CENTRAL RAILROAD BALLAST TABLE
SHOWING CUBIC YARDS PER MILE OF TRACK

Material	Size of Ties	Double Track	Single Track		
			Class A	Class B	Class C
Rock	6″×8″×8′0″	6,891	3,488	2,692	....
	7″×9″×8′6″	7,341	3,784	2,966	....
	7″×9″×9′0″	7,496	3,916	3,081	....
Cementing gravel	6″×8″×8′0″	....	2,747	2,291	1,868
	7″×9″×8′6″	....	2,887	2,414	1,975
	7″×9″×9′0″	....	2,995	2,506	2,050
Loose gravel and cinders	6″×8″×8′0″	7,325	3,825	3,014	2,287
	7″×9″×8′6″	7,924	4,168	3,311	2,536
	7″×9″×9′0″	8,061	4,302	3,428	2,635
Earth	6″×8″×8′0″	....	....	....	499
	7″×9″×8′6″	....	....	....	541
	7″×9″×9′0″	....	....	....	551

RAILWAY TERMINAL FACILITIES

L. C. FRITCH, ASSISTANT TO THE GENERAL MANAGER, ILLINOIS CENTRAL RAILROAD

The function of a railway corporation is the transportation by rail of passengers or persons, and goods or property. To perform this function with dispatch and economy, facilities of various kinds are required, which may be classified as follows: (1) permanent way, embracing tracks and structures; (2) rolling-stock, comprising equipment, such as locomotives, cars, etc. These two classes constitute the essential elements —or tools, as it were—of the work of transportation. Their subdivisions would fill a volume, and will not be entered into here. We shall dwell upon the former class only long enough to separate from it the topic assigned.

"Permanent way" may be defined as that portion of the physical property of a railway which has permanent location—such as rights of way, station grounds, real estate or lands, tracks, bridges, buildings, docks, wharves, etc.; as distinguished from physical property used in transportation, or movement of traffic—such as locomotives, cars, etc. "Terminal facilities" may be regarded as that subdivision of permanent way which embraces the handling of traffic at points of origin and destination, and may be divided into two classes: (*a*) passenger terminal facilities; (*b*) freight terminal facilities. The word "terminal" literally re-

fers to the ending or final point, and, in this sense, really comprises facilities for the delivering and receiving of traffic at its points of origin and destination, or at the ends of its movement.

There are various classes of terminal facilities, which may be described as follows: (1) local terminal facilities, or the facilities for handling traffic at a local or way station, along a line of railway; (2) intermediate terminal facilities, or the facilities for handling traffic at an intermediate point on a line of railway, such as a division, or district terminal; (3) final terminal facilities, or the facilities for handling traffic at the terminus of a railway division, district, or line. The foregoing are properly divided into passenger and freight terminal facilities.

Local terminal facilities are so simple in their nature and so limited in their extent as to require only a brief explanation. Local passenger terminal facilities usually consist of an independent building used for the purpose of a passenger station, and are commonly divided into three classes, as follows: Class A—a building having two waiting rooms, one for women and one for men, a ticket office serving both waiting-rooms, and a baggage- and express-room, either jointly or separately constructed, depending upon the size of the station served; Class B—an independent building similar to the above, having only one waiting-room, and a wareroom used jointly for merchandise freight, express, and baggage; Class C—an independent building of large dimensions, used exclusively for passenger service, with or without sheds over the tracks, and confined

to cities of large population. The latter class includes stations or terminals in large cities.

PASSENGER TERMINALS

The extreme types of passenger terminals in this country are represented by the New York Central Station in New York City, the South Boston Station of the New York, New Haven & Hartford in Boston, the Union Station in St. Louis, the proposed new passenger terminals of the Pennsylvania Company in New York City, and the Union Terminal in Washington, D. C., now in process of construction. To give an adequate description of merely the largest passenger terminals is beyond the scope of a brief paper, and, therefore, reference may be made only to the salient features of some of those mentioned above. Those of lesser note will be left out of consideration, though many of them possess interesting and novel features, and each is worthy of careful study.

The architecture of modern railway passenger terminals is in itself a field for the specialist, and many noted engineers are making it their life-work. Next in importance, if not of equal importance, is the track arrangement at important terminals. There are two varieties: (1) through-track arrangement, where trains enter at one end of the train-shed and depart from the opposite end; (2) pocket- or spur-track arrangement, where trains enter and depart from stub- or spur-tracks. The through-track arrangement is the most desirable from every point of view, as it obviates the undesirable feature of backing trains into or out of a terminal sta-

tion, which must be done in the case of a pocket arrangement. Location and available space often limit the design, or modify it to the extent of permitting only a pocket arrangement, or a modification of it in the form of a combination of a through and pocket arrangement.

Passenger terminal accessories.—The necessary appurtenances to passenger terminals are: (1) baggage-, express-, and mailrooms; (2) passenger-coach and equipment yards; (3) passenger-locomotive house.

1. Baggage-, express-, and mailrooms at passenger terminals of large cities form an important part of the required facilities, and must be provided with regard to economy in operation, as well as to ease in properly conducting these branches of the service. As a rule, such facilities are arranged in close proximity to the entrances to the train-shed, and are provided with tracks for accommodating the different kinds of goods handled.

In the handling of baggage, the inbound and outbound business are usually separated, but immediately adjoining each other. A further subdivision of hand baggage and large baggage is made. The former is usually received from, and delivered to, passengers directly, and requires a location convenient to the main entrance to the station; the latter is handled by transfer companies, and is received and delivered at a more remote point, and more nearly at the point of receipt from and dispatch to the trains. It is the common practice to handle baggage of all kinds, between the baggage-rooms and

trains both on inbound and outbound business, by means of trucks. This is done for the purpose of expediting delivery as well as for quickly handling baggage received for shipment a short time prior to the departure of trains. In cases of large shipments, such as theatrical baggage, baggage-cars may be switched into tracks at the baggage-rooms; but the custom of handling baggage directly from the station platform is almost universal in this country.

In the handling of express matter a somewhat different practice is followed. The express buildings are usually located at a point at or near the ends of train-sheds. The express matter is handled through the warerooms of the express building, where it is classified and loaded directly into cars on outbound business. In the case of inbound business the express-cars are usually placed on tracks at the warehouse, and the freight is unloaded into the house from which distribution is made. This practice is departed from in cases where both express and baggage in limited quantities are handled in one car, when the former is usually handled in the same manner as baggage.

Mail matter is handled in various ways. In the case of outbound mail, cars are usually placed at the mail-room, or on the receiving-track convenient for receiving the mail directly from the mail-wagons. A short time before the scheduled departing time of the train the mail-cars are switched into the train-shed, and mail may be received by means of trucks until the time of departure. In the case of inbound mail it is usual to unload all high-class matter directly from the cars im-

mediately upon the arrival of the train, and other matter from the mailroom track into wagons.

The handling of baggage, express, and mail offers perplexing problems in the operation of large passenger terminals. Many plans for overcoming the obstruction of platforms by trucks have been devised, principal among which is a system of ample and convenient subways, with elevators; but the problem has not yet reached a satisfactory solution, and the most modern facilities still reveal the objectionable features of interference with passengers on the platforms. The application of overhead carriers has an advantage in keeping trucks off the platforms except at the actual points of delivery and receipt, and promises an eventual elimination of this difficulty. In Chicago, the Illinois Tunnel Company's underground system will soon be used, in handling mail, communication with the train-sheds being provided by means of chutes and elevators.

2. Passenger-coach and equipment yards are usually divided into two parts: (*a*) a coach storage-yard, where coaches and other passenger equipment are stored ready for use, being "made up" or switched in the order in which the equipment is required for use in trains; (*b*) a cleaning-yard, where the equipment is placed immediately after arrival, to be cleaned and made ready for use. The storage-yard is usually a simple series of parallel tracks of capacity to hold a train of maximum size; the tracks being, in some instances, designed to serve also as a cleaning-yard, where cars may be cleaned without taking them to a separate cleaning-yard.

The cleaning-yard is a specially designed yard, with

tracks spaced a sufficient distance apart to permit the cleaning of the outside of cars on adjoining tracks. A system of water-, air-heater, and gas-pipes extends throughout the yard, with frequent connections so arranged that use may be made of any of these necessities for any car. The renovation of the passenger equipment forms a most important part in the passenger service of today. At the end of each trip or run it is now customary thoroughly to renovate both the interior and the exterior of each passenger-car, entailing a large force of men and no small expense. In this work the vacuum system of cleaning by means of compressed air is now largely employed, resulting in great economy and in increased facility in producing sanitary results. The cost involved in the use of the compressed-air system is about one-half of that of the old method of cleaning.

3. At large terminals it is customary to provide separate and independent locomotive-houses for the accommodation of engines used in passenger-service. These houses are of two types: (*a*) the conventional round or circular houses, with turn-tables at the center of the circle; and (*b*) the rectangular form, with transfer-tables to shift engines from one location to another, or to receive and dispatch engines; the table in some cases being replaced by an arrangement of switches providing access to any location in the house from either end. A recent design of a rectangular house, with an ultimate capacity of 40 locomotives, shows an area of 80,000 square feet for the rectangular form, as against 122,000 square feet for a circular house of

the same capacity. Allowance, however, must be made for a turntable, which must be added to the rectangular house arrangement.

Provision must also be made for cleaning the ash-pans of the engines, knocking the fires out of the fire-boxes, coaling, watering, and sanding the engines; also for blowing off the steam from the engines at the end of the runs, washing out the boilers, and kindling fires by means of oil, gas, or wood. Facilities for making running repairs to engines, with drop-pits so that the driving-or track-wheels may be dropped under the engines without raising or jacking them up, are likewise necessities.

Important passenger stations.—Attention is now called to a few leading passenger stations.

The new Union Station at Washington, D. C., which is intended to be, it is said, the finest railway station in the world, will be completed by this autumn (1906). The estimated cost is about $18,000,000, shared by the railways, the federal government and the District of Columbia. The train-shed will be 760 feet wide and 705 feet long, and will contain 33 tracks, of which 13 will lie on a lower level than the remaining 20, the former being through-tracks to accommodate the service which will use the tunnel under Capitol Hill. The general waiting-room will be 130 by 220 feet, and will be covered by a Roman barrel-vault 90 feet high. The passenger concourse, or lobby, will be 760 feet long by 130 feet wide, and will be divided into an outbound concourse, 80 feet wide, and an inbound concourse, 50 feet wide.

The Union Station at St. Louis has, perhaps, a larger number of railways using it than any other station in the world. This station was remodeled in 1904 for the traffic arising from the Louisiana Purchase Exposition, which was handled with great success. The train-shed is a pocket-shed, 601 feet wide and 810 feet long, and has 32 tracks. The passenger concourse is 120 feet wide—70 feet wide for outgoing and 50 feet wide for incoming passengers. The entrance to the train-shed provides for two three-track Y-connections from each direction. The express buildings are all located alongside and west of the track approaches to the station, each building being provided with independent track connections. The baggage-room for small baggage is located alongside the concourse, but the baggage-room for wagon baggage is located under the south end of the train-shed. Subways are provided for handling baggage and express, and communication with the platform in the train-shed is had by means of elevators.

The passenger station of the Boston Terminal Company has the unusual feature of a substation located under the main station for the purpose of handling suburban traffic. The train-shed is 620 feet long and 620 feet wide, and has 28 train-tracks. The substation has a double track, spread at the platforms. The substation tracks are entirely below the grade of the surface tracks. The inbound baggage-room is located on the east side, and the outbound baggage-room on the west side, of the train-shed, with a subway for handling both express and baggage. The express buildings are located on the west side of the tracks approaching

the station, the buildings being provided with independent tracks for express-cars.

FREIGHT TERMINALS

"Freight terminals" may be defined as the facilities for the handling of freight traffic, and includes two classes:

1. *Combination freight and passenger facilities,* where both freight and passengers are handled, and consisting of the usual arrangement of an addition to, or part of, a station building assigned to the handling of freight or property. These are so simple in character as to require no further description, their extent varying with the amount of traffic to be handled.

2. *Independent facilities,* used exclusively for handling freight or property, and varying in character and extent from a simple structure of small dimensions, serving the smaller stations, to the extensive structures and their appurtenances, serving the freight traffic of a large city. Wherever separate or independent facilities are required to handle the traffic, the general or fundamental requirements are the same. Consequently, a description of the larger facilities will include those of less magnitude.

The freight traffic of any railway is divided into two classes: (*a*) carload lots—property being handled in units of a carload of some specified minimum; (*b*) less-than-carload lots—property being handled in small units, each constituting less than a carload or lot. These two classes are respectively called, in railway parlance, "C. L." and "L. C. L." freight, and will be so designated in this paper.

The terminal facilities for any large freight station or terminal must include the following: (1) Freight-yards, for the purpose of receiving, classifying, storing, and forwarding freight-cars; also the necessary appurtenances, such as repair-yards, engine roundhouse, and equipment to care for freight locomotives. (2) Freight stations, including freight-houses, transfer-houses, warehouses, elevators, platforms, etc., for receiving, delivering, storing, transferring, etc., freight to and from cars. (3) Team-tracks, for the purpose of handling freight directly to and from wagons and cars. (4) Industry tracks, for the purpose of receiving and forwarding freight directly from and to industrial plants; the tracks extending into such plants, thus eliminating the necessity of drayage or transfer of freight by wagons. (5) Water terminals, for the purpose of interchange of freight between rail and water-craft; including docks, wharves, piers, elevators, warehouses, etc. These facilities will be briefly described in their order.

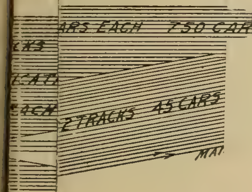
1. *Freight-yards.*—The modern freight-yard of large capacity is usually designed on the following general lines:

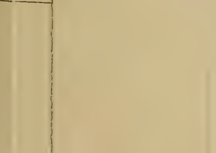
First, a receiving-yard, in which the inbound trains are received directly from the main line, and into which they are taken by the road crews, who are relieved at this point. The tracks in the receiving-yard diverge from a common ladder track, a certain number of tracks having a common ladder, and are of a length to accommodate a maximum train. The modern practice is to provide tracks from 75 to 90 cars in length, the unit of car-length being 40 feet.

Next in order to the receiving-yard is the classification-yard, reached by one or more lead-tracks so connected that any track in the receiving-yard is directly accessible to the classification-yard. The classification-yard is the working-center of the freight-yard, where cars are separated, classified, and assembled. Three types of classification-yards are now in use: (*a*) a yard in which the cars are classified "on the level"—by which is meant the shunting process, or the pushing and pulling alternately of the cars by the switch-engine; (*b*) a poling-yard, or one in which the classifying is done on inclined tracks—the switch-engine, with a pole, running on a track parallel to the lead-track, starts the cuts down the grade, whence they run by their combined momentum, aided by gravity, into the assigned track in the classification-yard; (*c*) the summit- or hump-yard, in which the cars are run to the summit of a grade, which rapidly descends into the classification-yard, the cars, after being detached at the summit, running down, under the action of gravity, into the assigned classification-tracks. The utility of these three types of classifications is best exemplified by the following record of a test made in classifying a sixty-car train by each of the three methods:

	Level	Poling	Hump
Number of cars...........	60	60	60
Number of cuts...........	50	50	50
Number of men...........	5	9	9
Time consumed...........	2 hrs.	1 hr. 15 m.	30 m.
Wage expense.............	$2.44	$1.55	$1.02

The summit- or hump-yard has become a necessity


ARS EACH 750 CAR
2 TRACKS 45 CARS


RECEIVING
10 TRACKS 30
DEPARTURE
10 TRACKS 30

AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING 1902

TYPES OF CLUSTERS

in a modern large freight-yard, where a heavy volume of business is done. The classifying-yard is usually the limit of the capacity of the entire system. In the design of the summit- or hump-yard great care must be exercised to adopt a gradient that will carry cars the necessary distance into the classifying-yard.

The number of tracks required in a classifying-yard depends upon the number of classifications to be made. The yard of the Chicago Union Transfer Company at Chicago has 42 tracks, of 60 cars' capacity each. The length of the tracks depends upon the maximum number of cars usually handled per train, and ranges from 45 to 90 cars. Track-scales are usually located on the summit or hump.

Next in order to the classification-yard comes the departure-yard, directly connected with the former, so that each track in the latter may be reached from any track in the former. The length of tracks in the departure-yard varies from 45 to 90 cars, depending upon the number of cars handled in trains. In some cases the classification-yard, by suitable extension of its capacity, also serves as a departure-yard.

In close proximity to the classification-yard is usually located the repair-yard, consisting of tracks widely spaced from 16 to 22 feet center to center, and from 15 to 20 cars' capacity, for the purpose of repairing cars in bad order.

The storage-yards are usually located alongside of the classification- or forwarding-yard, and are used for the purpose of holding cars for disposition. It is often necessary to reclassify such cars, and, therefore, con-

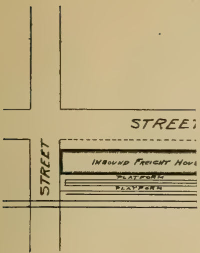
nection must be made to permit them to be rehandled through the classification-yard.

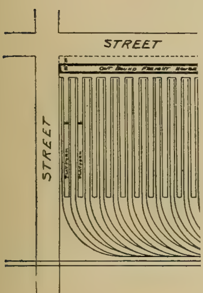
Ample leads for running track and communications with all parts of the yard system are provided, so that there may be no interference with the yard operations, especially the classification of cars, which is the vital point in the entire business of the yard.

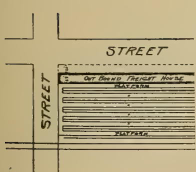
It is the modern practice to provide separate systems, as above described—one system for the traffic in one direction and a duplicate system for the traffic in the opposite direction ; the purpose being to enable traffic constantly to move in the direction of its objective point, avoiding false or backward movements.

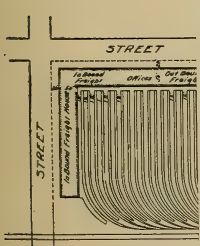
2. *Freight stations.*—A modern freight station of large dimensions includes such facilities as freight-houses, transfer-houses, warehouses, elevators, platforms, stock-pens, etc., and is used for the purpose of receiving and delivering freight by the railway from and to the public. Both C.L. and L.C.L. shipments are handled. Certain fundamental principles have been evolved, and are now generally accepted in the establishment of modern freight-station facilities.

Freight-houses usually consist of inbound and outbound houses. At the inbound house incoming freight is received, being unloaded directly into the house from tracks along the side. Usually not more than two tracks are required, the unloaded cars being pulled to be replaced with loaded ones. The object of this restriction of the number of tracks is to reduce the distance that freight must be trucked from the cars to the house. Modern practice limits the width of inbound freight-


STREET
STREET
INBOUND FREIGHT
PLATFORM
PLATFORM

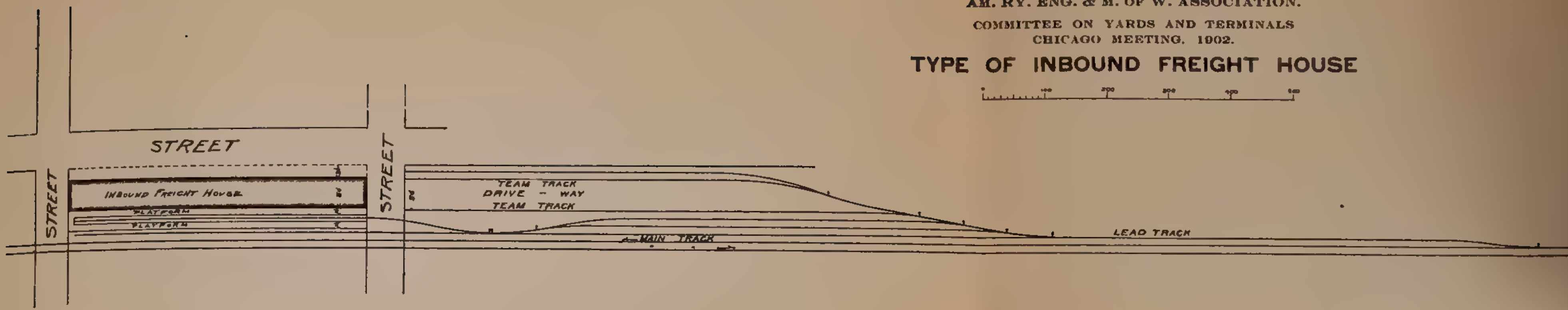

STREET
STREET
Out Bound Freight House
Platform
Platform


STREET
STREET
Out Bound Freight House
PLATFORM
PLATFORM


STREET
STREET
In Bound Freight
Offices
In Bound Freight House

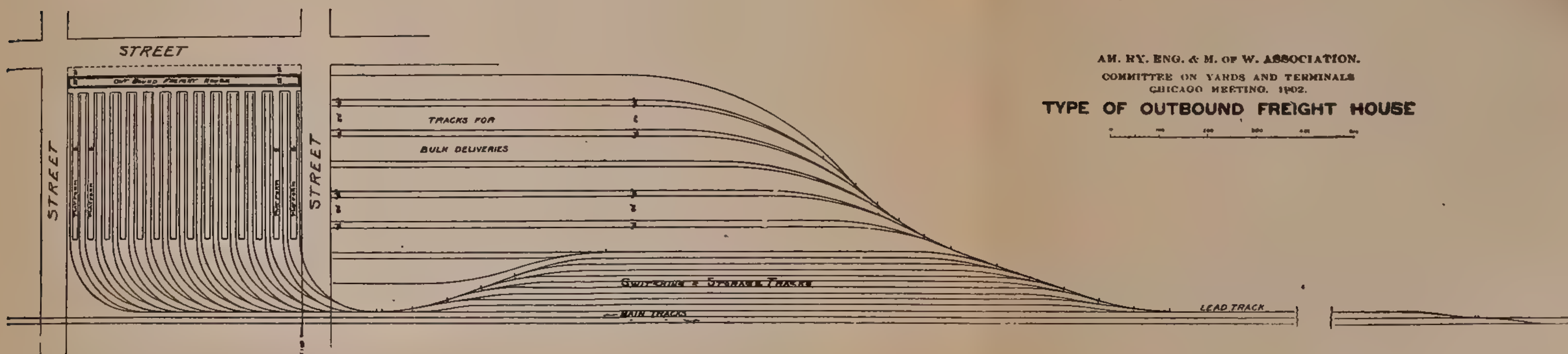
AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF INBOUND FREIGHT HOUSE



AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF OUTBOUND FREIGHT HOUSE

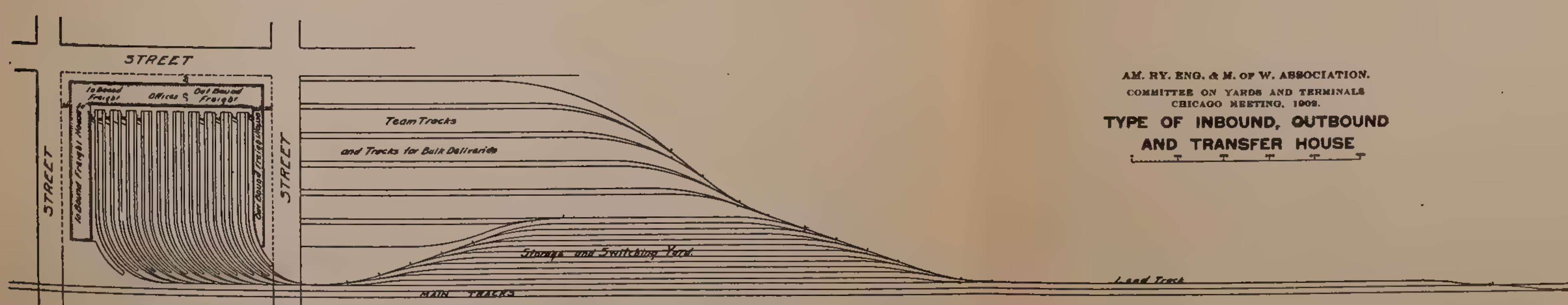


AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF OUTBOUND FREIGHT HOUSE

AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF INBOUND, OUTBOUND AND TRANSFER HOUSE



houses from 60 to 70 feet, the length varying with the requirements, regulated by the volume of traffic. It is customary to provide a platform 8 to 10 feet wide on one or both sides of the house, which permits cars to be placed at any point opposite the house, and also furnishes accommodation for the maximum number of wagons on the delivery side of the house. Paved driveways, not less than 50 feet wide, should be provided on this side of the house. The doors of the house should be placed uniformly 40 feet center to center, in order to come approximately opposite the car doors when the cars are placed at the house. The house is usually posted in a systematic manner into sections numbered or lettered, and when freight is unloaded, notations are made on the freight-bills showing location, in order that it may be readily located.

In L.C.L. freight-houses, which are used in handling merchandise in mixed lots, only one floor, as a rule, is provided. C.L. freight is not usually handled in such houses, but, when so handled, is often held for storage. In this case usually a number of stories is provided, the freight being raised by means of elevators. The most approved type of elevator is the electric, which is both economical and efficient.

The outbound house is used for the purpose of forwarding shipments received from wagons delivering at one side of the house. The freight is weighed as received, and then trucked directly into the outbound cars on tracks along the other side of the house. The modern practice is to limit the width of the outbound house to 30 or 35 feet, in order to reduce the

trucking distance over which the freight must be handled. The tracks are placed alongside of the house on the side opposite the driveway. They are usually spaced closely together, and as many tracks are provided as the number of cars' capacity for the daily loading requires. It is customary to provide an outside platform on the track side for convenience in longitudinal trucking; but the wagon, or receiving, side is usually provided with a line of doors closely placed, so that nearly the entire side of the house is open for receipt of freight.

Wherever space permits, it is good practice to place the inbound and outbound houses opposite each other, with the tracks between the houses and a transfer platform between two sets of tracks for the purpose of transferring cars. This arrangement is a flexible one, to the extent that the track arrangement can be utilized for either house to any desired limits; also, the transfer freight can be handled at the same time with the inbound and outbound freight. Furthermore, the freight-house forces are easily interchangeable, and full advantage can be taken of the fact that in the morning the inbound freight is heavy and the outbound freight light, which conditions are reversed in the afternoons, thus keeping the forces uniformly engaged during the entire day.

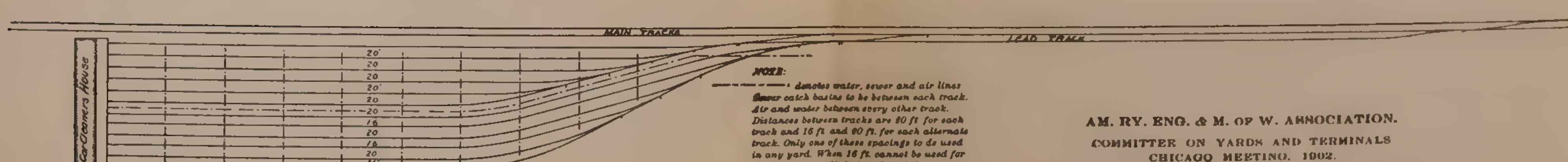
Transfer platforms are used for the purpose of shifting freight from car to car. Usually the freight from one car is distributed throughout many other cars. In the case of L.C.L. freight the inbound cars are placed on one side, and the outbound cars on the opposite side, of transfer platforms. The usual widths of trans-

AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF INDUSTRIAL DISTRICT YARD

AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF DIVISION TERMINAL YARD



NOTE:
— - — - — denotes water, sewer and air lines
Sewer catch basins to be between each track.
Air and water between every other track.
Distances between tracks are 20 ft for each track and 16 ft and 20 ft. for each alternate track. Only one of these spacings to be used in any yard. When 16 ft. cannot be used for tracks in pairs, 14 ft. is to be minimum distance

AM. RY. ENG. & M. OF W. ASSOCIATION.
COMMITTEE ON YARDS AND TERMINALS
CHICAGO MEETING, 1902.

TYPE OF CAR CLEANING YARD

fer platforms are from 12 to 20 feet. They are usually provided with a canopy or roof for the protection of men and freight. The transfer platform is most conveniently located when it is placed between the inbound- and outbound-house tracks, as inbound cars often contain freight both for city delivery and for outbound cars, which can thus be handled with economy.

Warehouses are usually provided for the purpose of storing freight, both inbound and outbound; but the regular business of warehousing is one apart from transportation, and in many states the laws prohibit railways from doing a warehouse business, other than such as is incidental to the transporting of the goods. Warehouses are therefore not essentially a part of railway terminal facilities, when considered strictly as warehouses.

Elevators are provided for handling grain for the purpose of storage, cleaning, clipping, drying, sorting, or transferring from cars to vessels. The usual type, almost a universal one, is a system of tracks constructed over pits into which the grain is unloaded, thence being carried into bins by means of conveyors. Chutes are provided for loading cars on the same tracks when grain shipments are outbound. Marine conveyors are provided for carrying the grain from elevators to vessels, when the elevators are located at a point removed from the vessels' landing. In case of elevators directly alongside of vessels, chutes are used.

Platforms for handling large and heavy shipments, which cannot be readily loaded directly from cars to wagons, or vice versa, are usually provided, so ar-

ranged that cars can be placed directly at the platform. A common form is a pocket track, with the floor of the platform at the same elevation as the floor of the cars. A derrick should be provided to handle heavy shipments: one of the traveling type, spanning the platform, two tracks, and the driveway, is the most efficient. It provides the means of transferring shipments from car to car, from car to platform, or for loading or unloading between wagons and cars.

Stock-pens at large terminals are usually provided by stock-yard companies, but separate and smaller pens are also, as a rule, required at all terminals to handle shipments of stock. The common type has chutes for the loading and unloading, and is subdivided into smaller pens, holding from one to several carloads each. Watering and feeding facilities should also be provided, and, in many cases a shed roof over one-half of the pens is constructed for the protection of the stock from bad weather.

3. *Team tracks.*—The handling of carload freight, which is loaded or unloaded directly from or into cars and wagons, requires "team tracks." These are usually constructed in pairs, with a paved driveway between each pair not less than 40 feet wide. Large quantities of carload freight are handled by this means. It is usual to subdivide the team tracks into the various classes of traffic handled on them; for example, there may be "coal team tracks," "lumber team tracks," "merchandise team tracks," "perishable freight team tracks," etc.

4. *Industry tracks.*—"Industry tracks" is the

name usually applied to tracks leading into industrial, manufacturing, or commercial plants. It is becoming more and more the custom for industries to be located along the line of a railway or to be connected directly with such line by means of industry tracks, thus eliminating the handling of freight by means of wagons—a most expensive process. It often costs as much to transport a ton of freight one mile by wagon as it does to carry it 100 miles by railway. Industry tracks also make it possible to do away with the additional double handling of freight, with its increased danger of breakages, etc.

5. *Rail and water terminals.*—Rail and water terminals are provided at points of interchange of traffic between rail and water transportation. The facilities desirable are as follows:

Piers, either open or covered, on which freight is loaded and unloaded from cars to vessels, or vice versa, either directly from one to the other, or first handled on the floor of the pier and then transferred to cars or vessels. In the latter case double handling is required. Special types of piers are provided for various classes of freight—such as coal, and general export and import merchandise.

The term "pier" is commonly applied to the construction of facilities where slips are used, the piers being accessible to vessels at the sides. In some instances, however, docks or wharves are necessary which lie parallel to the water; as, for example, the export wharves on the Mississippi River at New Orleans. Up to the present time slips and piers have not been used

there, largely on account of the deposits of silt from the river, making the practicability of slips doubtful.

No typical plans for water terminal facilities can be suggested. Conditions of traffic and limits of available space, when ocean, lake, or river terminals are in question, so affect the problem that each individual case requires its own design to suit local conditions. But a few general recommendations as to various types of piers may be mentioned.

Covered lighterage piers, where cars are loaded or unloaded directly from or into vessels, should be about 600 feet in length, with two depressed tracks. The width should suit the conditions of traffic, which, if moved promptly, requires less width than if stored for some time. The widths should be from 125 to 160 feet. The distance between piers, or the width of the slips, should be about four times the width of the largest vessels. Open lighterage piers. where bulk freight, which does not require protection from weather, is handled, need not be more than half the width of covered piers.

Export, import, and storage piers should be of sufficient length to accommodate at least two vessels on each side of the pier, or from 1,000 to 1,400 feet long, and should be from 125 to 160 feet in width. The width, however, should not be so excessive as to increase unnecessarily the cost of handling. The tracks should be depressed so that cars can be readily loaded and unloaded. The width of the slips should be not less than four times the width of the largest vessels using them.

Coal piers should be open piers, and, where possible, coal should be dumped from drop-bottom or side-dump cars through bins and chutes directly into the vessels, by gravity. Where, however, elevating machinery or derricks are used, elevated dumps are not necessary.

Station piers, served by car-floats, may be from 600 to 800 feet in length, and from 125 to 150 feet in width, with a depressed driveway through the center not less than 35 feet wide. The pier should be inclosed, and usually has provision made for a storage, or a second floor for offices and storage-rooms. Station piers should have slips from 150 to 200 feet in width.

RAILROAD SIGNALING

CHARLES A. DUNHAM, SIGNAL ENGINEER, GREAT NORTHERN RAILWAY

In the operation of a railroad the question of signaling is one of growing importance, and more attention is being paid to it each year. As the subject is of great breadth, it will, however, be impossible here to deal with more than its fundamental principles. Almost from the first inception of the railroad the necessity for some means of protecting trains was made evident, and the present methods are developments of the rudimentary expedients first used.

The subject of signaling divides itself naturally into two headings: interlocking signals, used at junctions, grade crossings, yards, or sidings; and block signals, used for the spacing of trains, with the object that rear-end, head-end, or other collisions may be avoided. As stated, it was early found that some method of protecting trains was absolutely necessary; and this can the more easily be understood when it is remembered that the electric telegraph was not used in connection with railroad operation until about the year 1840. Up to that time trains were operated and meeting-points made by the time card. Under this method of operation it is not difficult to see the possibility of collisions, and, to overcome this difficulty, semaphore signals were installed certain distances apart, a man being stationed at each signal to operate it. The

semaphore, prior to its application to railroad operation, had been used as far back as 1767 for the transmission of messages at considerable distances. This early type of semaphore has gone through several modifications. At present it consists of a blade or blades pivoted on a mast and fitted with colored glasses, so that its indications may be read by night as well as by day. These indications are given by a horizontal position of the blade for the "stop" signal, and an inclined position of the blade for the "proceed" signal. Like information is given at night by the display of colored lights, red indicating "stop," and green or white "proceed." When green is used for the "clear" night signal, yellow is frequently used as the "caution" signal.

As the time of the men engaged in operating these signals was not very fully occupied, it became the practice to connect switches in the vicinity of the semaphore by means of mechanical lines of connection, and these switches were operated by the signal men with levers from a central point. This crude method of signaling led to mistakes, and very probably to accidents, as trains were at times turned on to the wrong tracks through carelessness or oversight of the signal men.

In the year 1856 a simple lock between the levers was introduced by Mr. Saxby. It was not until 1859, however, that Saxby & Farmer, and Stevens & Sons, took out patents; the former for the spindle locking, and the latter for the tappet locking. As originally applied, this locking was attached directly to the lever; but, on account of the severe strain that could be put

upon the lever, this was not found to be satisfactory, and toward the end of the same year patents were taken out in which the locking was applied to the latch of the lever. This is the method now in use.

Just here we will consider what an interlocking plant is. It usually consists of a number of switches, derails, and signals connected with levers located in a tower-house building at a central point. These levers are so interlocked that it is impossible for the lever-man to set clear signals for the passage of trains on conflicting routes. The combinations as arranged in the interlocking are such that the switches and locking devices must all be properly set before the signals can be cleared, and when the signals are cleared, the locking precludes the changing of the switches or derails until the signals have been restored to their normal position, which is the "stop" or "caution" position, as the case may be.

One of the first interlocking plants used in this country was installed at Spuyten Duyvil Junction in New York City in 1874. This interlocking machine was very similar to those we now have in use, and it is preserved, I am informed, in the Field Columbian Museum. From the small beginning made at Spuyten Duyvil, signaling has grown steadily, and in later years especially has developed rapidly. The demand for signal devices today is such that we have several large signal-manufacturing plants, capable of turning out hundreds of levers per day. In speaking of levers, I include all of the equipment that goes with them. All of the interlocking plants installed in the earlier days

were of the mechanical type. During the last ten or fifteen years it has been found desirable to use power systems of interlocking at the larger plants. In fact, today most railroads use power systems where more than fifty or sixty levers are used. I know of one little power interlocking machine, used in Iowa, which has only two levers, and a charging plant to provide the power for the two levers was installed especially for that purpose.

The power systems of interlocking now in vogue may be said to be three in number—namely: the "low-pressure pneumatic" system, the "electro-pneumatic" system and the "all-electric" system. Under the low-pressure pneumatic system the plant is purely mechanical, and the switch and signal operations are accomplished by compressed air, usually at a pressure of about two atmospheres. The electro-pneumatic system is used extensively. It varies from the low-presure pneumatic system in that the control of the air-valves in the operating mechanism, as also the return indications, are electrical. It is necessary that the lever-man know that the switch or signal has followed the lever movement; and, to accomplish this, the interlocking machine is so controlled that the locking is not released until the switch or signal movement has been completed. The release of the locking is necessarily accomplished prior to the clearing of a signal. The pneumatic system of interlocking can frequently be used to great advantage. This is especially true where air-pressure is available, which is often the case, as compressed air is used for various purposes on a rail-

road. When it is necessary to instal a power plant solely for the purpose of compressing air for an interlocking plant, the cost of the power is considerable.

The third power system of interlocking is the all-electric system. Under this system each switch, derail, and signal is equipped with a motor, and the motors are controlled through the interlocking machine. The electric power required is usually taken from a storage battery. One of these storage batteries, of 150 ampere hours' capacity, will, when fully charged, provide power for the operation of a large and busy interlocking plant for a period of seven or eight days; and when we consider the fact that the storage battery can be charged in a few hours at a very small cost, the advantages of the all-electric system are apparent. One of the chief advantages of the power systems of interlocking over the mechanical system is that the switches and signals can be operated at much greater distances, while the cost of operation and maintenance, if the plant is a large one, is reduced.

Now, having outlined the interlocking systems as applied on railroads, let us consider the block systems of signaling. Practically only four systems of block signaling are in use at the present time—namely, the "telegraph block," the "controlled manual block," the "staff block," and the "automatic block" systems. Before going farther, it might be well to define what we mean by a "block" as understood in railroad signaling.

A block is a section of track governed by a home signal, and the object of dividing the line into sections is to prevent two trains from occupying a section of

track at the same time. These blocks may be of any length consistent with the economic operation of trains. As the first division of the four systems of block signaling we will consider the telegraph block. Under this system the signals are located at given distances along the railroad, usually two or three miles apart, and men are provided at each block cabin to operate the signals. Means of communication between block cabins are provided either by telegraph or by telephone, and may be accompanied by a system of bell signals, whereby the block operators communicate with one another. This system of block signaling is very simple and has been found to be quite effective.

As an improvement on the telegraph block system we have the controlled manual block system. By this is meant that, with this system in force, a block operator cannot clear the signal at his own station without the co-operation of the operator in advance of the proposed train movement. The advantages of this feature are very apparent, and they are made possible by applying electric locks to each signal. For instance, let us suppose that we have three block stations of the controlled manual type in use—A, B, and C. The block operator at station A has a train ready to proceed toward station B. The block operator at A must communicate with the block operator at B, and if the block is clear between A and B, the block operator at B will unlock the electric lock on the signal at A, and the operator at A will clear his signal and permit the train to proceed toward B. The block operator at B therefore has knowledge of the approach of the train

from A, and he in turn will make arrangements with the operator at C for the unlocking of the signal at B. This method is continued for the entire distance covered by the manual block system. It will be seen that by this arrangement all of the block operators are checking each other, and that each operator has full and complete knowledge of all train movements being made in the blocks on either side of his own station. Under this arrangement train movements can be made safely and expeditiously. This system is one which originated, I believe, in England. As to the construction cost of the controlled manual block system, I may add that the locking devices are the only additional expense over and above that of the telegraph block system, and experience has shown that the controlled manual block system is much superior to the ordinary telegraph block.

Under the controlled manual system it is possible materially to cut down the number of train orders issued by the Train Dispatcher, and an additional advantage of great importance can be provided by connecting the passing-track and other main-track switches, and placing them under the control of the block operator. When these features are provided, trains which are required to leave the main track at meeting-points are turned on to the side-tracks by the block operators, the switches are reset for the main track, and the train of superior right is allowed to pass. During the time this movement has been under way the train which took the siding may be pulled to the far end of such siding, and is again allowed to pro-

ceed on its way by the block operator clearing the advance signal.

These facilities for handling trains are of great advantage; and it is my opinion that the day will come when trains may be handled with perfect safety on a single track without the giving of a single train order to the train crews. The dispatchers will give all orders to the telegraph operators who will execute the orders and control the trains by means of the signals provided at their respective stations. I freely admit that this would be a radical departure from established practice, but I am convinced that the details can and will be worked out which will make this method of railroad operation entirely practicable.

The "staff" system is an English invention, and is used quite extensively throughout Great Britain. As installed, it consists of a staff instrument placed at the beginning and end of each block, the instrument containing staffs of metal which are held in a receiver. The staff instruments at each end of the block are interlocked electrically, so that, if the staff is taken out of one instrument, both instruments are locked until the staff is returned to one or other of them, when another staff may be taken out. In operation the engine-man secures a staff at one instrument, which gives him right of way to the next staff instrument, where he deposits the staff belonging to the block which he has just cleared. Here he secures another staff for the next block ahead, and in this way makes sure that he has a clear block ahead, as he is in possession of the staff controlling that block. From this description it may

be inferred that there is a great deal of time lost through trains stopping to deposit and receive staffs. In actual operation trains are not ordinarily required to stop at staff offices. The engine-man throws the staff covering the block which he is leaving to the block operator, and in turn receives from the block operator a staff controlling the block he is about to enter. This method of handling the staffs can be followed successfully at speeds up to thirty miles an hour. When trains operate at speeds of over thirty miles an hour, some railroads equip their locomotives with catching devices. These devices, in some respects, are similar to those employed on postal cars for catching mail. When catching devices are employed, the staffs are placed in suitable pouches, and these pouches can be picked up at a speed even as great as sixty miles an hour. It is not probable that the staff system will be employed extensively where trains are operated at high speeds. The system can, however, be used to very great advantage, particularly on stretches of gauntlet track, or where trains of several divisions, or perhaps of several railroads, are operated for considerable distances over one pair of rails. In a situation of this kind the ordinary train-order system is abandoned, and all train movements are controlled absolutely by the staff system.

The staff system is susceptible of many variations. For instance, should it be desirable to hold two men responsible for train movements—and this might be true, we will say, at a tunnel where a pusher engine is used—the divided staff is employed, half of the staff being given to the engine-man in the ordinary manner,

and the other half to the engine-man in charge of the pusher engine; the block being held until the divided halves of the staff have been joined together and placed in the staff instrument at the opposite end of the block. If the staff system is employed through a yard where a good many light engine movements or switching movements are made, the main-track switches can be equipped with staff locks. With this arrangement in effect a light engine or switch crew is given a staff, and is allowed to proceed into the block, the block being held until the crew has returned or passed through the block and the staff has been deposited at the staff office. Thus the none too uncommon collision between the through train and a switch engine or switch train in the yard is avoided. A point which should not be overlooked is that, under the staff system, the possession of the staff gives the train full right to use the block in either direction—an advantage not provided in any other block signal system. A great many signal engineers are now alive to the advantage of having a pair of staff instruments available for immediate use in cases of emergency, such as are sometimes occasioned by the necessity of turning the traffic of a double-track railroad on to a single track temporarily. The staff system, in a case of this kind, can be put in effect inside of a few hours; all that is needed to handle the traffic with absolute safety is the staff instruments and a pair of ordinary telegraph wires between the junction points, and a few cells of dry batteries.

We have now briefly considered the telegraph block system, the controlled manual block system, and the

staff system. In conclusion I may state that the expense of installing the telegraph block is nominal. A well-regulated controlled manual system can be installed at a cost of about $200 per mile of railroad. These figures are on the basis of installing the signal equipments in established telegraph offices. Where it is necessary to erect block cabins, the cost of such cabins should be added. Suitable cabins can be erected at about $200 each. The cost of installing the staff system is about the same as the cost of installing the controlled manual system.

Before proceeding to discuss the automatic block signal systems, I wish to state that the manual block systems already considered are extensively applied to single-track railroads, while the automatic block signal system is, generally speaking, intended for use on double track. The automatic block signal is today installed in only two forms, namely, the semaphore and the inclosed disk. Some railroads continue to use the inclosed disk, because they believe it to be more efficient, quite as safe, and more economical than the semaphore type of signal. However, the semaphore type is more generally recognized, and undoubtedly a very large percentage of all the automatic block signals now being installed are of this type.

Everybody is familiar with the semaphore signals as seen along our railways, and while their significance may not be fully appreciated by the uninitiated, they are the guiding stars to safety for the engine-men and train-men. In order fully to appreciate this, I would advise a trip in the engine-cab over a railroad full of

curves and grades, and over which a large volume of important traffic is moved. The engine-man, with reason, places absolute confidence in the signal indications, and when the signals indicate "clear," he proceeds with full assurance that the way is clear. When a signal indicates "clear," the engine-man knows that the block ahead is not only free from trains, but that all the switches in that block are set for the main track; and he further knows that the cars and engines on the side-tracks all stand clear of the main line.

Automatic block signals may be and are erected to suit the peculiar conditions of the road signaled. I understand that in the underground railway in New York City the block signals in some cases are only 500 feet apart, and that trains pass over these blocks on their regular schedules a minute or less apart. On surface roads the length of block varies from one-quarter of a mile to four or five miles. I believe, however, I may safely state that the signal engineers of the country are agreed that it is not the best practice to instal extremely long blocks. An admirable installation of block signals, which lately came under my observation, consisted of blocks slightly less than two miles in length. Under this arrangement of signaling it was only necessary to place two cuts in the track circuit between each home signal. Each of these signal masts carried two arms, the upper arm in each case being the home or stop signal, and the lower arm being the caution or distant signal. Now, an engine-man running under these signals, and receiving two clear signals at the entrance to a block, knows that not only the block he is entering

is clear, but that the second block ahead is also clear. In other words, the engine-man receiving two clear signals in effect is told that four miles of railroad ahead of him are clear and free from trains, and that the switches are all set for the main track. It might be suggested that during the interval, while the train is covering the four miles of track, it would be possible for an engine or train to leave a passing track and occupy the main track in advance of the approaching train. Of this there is no doubt; but, to guard against this very possibility, the main-track switches are all provided either with bells, which will ring when a train is in the block, or with miniature signals of the semaphore type, which will give indication of a train in the block. In other words, when the block is clear and no train approaching, the little semaphore at the switch will indicate safety. When a train is in the block, this same little semaphore will assume the horizontal position and indicate danger, and train-men are not allowed to open a switch while the switch indicators stand at danger. I may say that, under the automatic blocking as installed today, all of the railroads are following practically the same system. One of the variations is that on some roads the signals stand normally in the "clear" or "proceed" position, while on others they stand normally in the "stop" or "danger" position. A good deal may be said of the relative merits of the two methods, and there is some difference of opinion as to the better plan.

When automatic signals are used, the rails in the tracks are bonded and cut into track sections by means

of insulating the rails from each other at intervals. Each track section is provided with a battery, usually of the gravity type, and a relay. The relay, while a section of track is not occupied by a train, is closed, and is opened by a train entering the block. The signals, in turn, are governed by means of contacts made by the track relays. The proper care and maintenance of the track sections is one of the important features which must receive very careful attention in automatic-block-signal maintenance. However, neglect in maintenance will not bring about dangerous conditions. When any part of the signal apparatus fails to operate properly, the signal will always give the danger indication.

Ordinarily the automatic block signal is operated either by compressed air or by electricity. At the present time a very considerable number of signals are being installed which are operated by carbonic-acid gas; and it may be of interest to know that an average of 200 signal operations can be obtained from each pound of gas. Each signal is provided with duplicate flasks of gas, and under ordinary traffic conditions, one flask of gas (fifty pounds) will furnish the power to operate a signal for a period of from six to nine months. When electricity is used as the power to operate the signal, each signal is provided with a motor, and the current is frequently taken from primary batteries. These batteries have been perfected to a very high standard, which may be appreciated more fully when I state that one set of cells, with practically no attention and no renewals whatever, will frequently operate a

signal on an average of thirty times a day for a period of from fifteen to eighteen months.

When the signals are operated by compressed air, it is usually on a very busy railroad, having not less than four tracks. The compressed air, generally, is used to operate the interlocked switches and signals, and may be used for other purposes along that particular line. Under ordinary conditions, it probably would not be advisable to use compressed air to operate the signals on one or two tracks, owing to the expense of compressing the air and piping it along the railroad.

I believe the automatic block signal to be entirely reliable, and years of experience with it by a great many railroads will bear me out in this statement. Quite recently Mr. Platt, reporter for the International Railway Congress, gathered exhaustive data, the result of which shows that we can expect almost perfect service; the actual figures showing one signal failure to 22,000 signal operations. Now, on the average railroad a signal will not perform over 15,000 signal operations in a year; it is therefore apparent that the railroad manager is not prepared to accept very many excuses for block signals failing and causing unnecessary interruptions to trains.

During the last year or two a good deal has been said about the use of storage batteries in connection with block signaling, and I think we are all agreed that the storage battery under favorable conditions can be used to very great advantage. However, for some time to come at least, the primary cell will hold its own. At the present stage of development, over the

greater part of this country, it would not be advisable to go to the expense of installing power stations and distributing lines for the sole purpose of providing electric current for block-signal operation.

In conclusion, it may be said that, under all ordinary conditions, a railroad can be well protected by automatic block signals at a cost of about $800 per mile of track, and, making allowance for depreciation and interest on this investment, the operation and maintenance of the system will cost slightly less than 20 per cent. per annum on the original investment.

CLASSIFICATION AND TYPES OF LOCOMOTIVES

C. A. SELEY, MECHANICAL ENGINEER, ROCK ISLAND SYSTEM

I. CLASSIFICATION OF LOCOMOTIVES

Boys living in seaboard towns become expert in classifying seagoing vessels by their general outline and sail arrangement; railroad men have to know the characteristics of their locomotives by definite terms, so as clearly to differentiate them. To the layman an engine is an engine, whether there are four or fourteen wheels under it; and, as it is mainly by the wheel arrangement that engines are classified or named, this branch of the subject may be taken up with profit.

A steam locomotive is a machine, in most cases designed for a definite end in handling freight or passenger equipment, and is therefore subject to mathematical analysis as to its power. This is generally expressed by the tractive power, the formula for which will be familiar. Stationary engines are rated by their horse-power; so that, when one speaks of a fifty-horse-power engine, a relative idea of the machine is conveyed to the mind. This impression is made more exact by defining the type—as to whether it is simple or compound, throttling or automatic, horizontal or vertical, etc. The term "horse-power" cannot be applied to locomotives in a comparative way, as some of the heaviest and most powerful ones exert only a mod-

erate horse-power. Locomotive horse-power is constantly varying with changes of speed and the adjustment of the valve gearing. The latter is also true of stationary engines, which are generally arranged for a certain speed, and a nominal rating calculated for that speed on an economical mean effective pressure; while the locomotive rating is based on the tractive power.

Most railroads have a variety of locomotive equipment, and, in order distinctly to define each lot or kind for records, drawings, patterns, and repair parts, the Motive Power Departments coin for themselves classifications, using numerals or letters, or both, in a purely arbitrary fashion. The Pennsylvania Railroad, for instance, uses the letter "A" for engines having two pairs of drivers and no trucks, "B" for three pairs, and "C" for four pairs; "D" is used for two pairs of drivers, and four-wheeled truck; "E," for two pairs of drivers, four-wheel leading and two-wheel trailing trucks; "F" has three pairs of drivers and two-wheel truck; "G," the same arrangement of drivers and four-wheel truck; and "H" has four pairs of drivers and two-wheel truck. This, it will be seen, is purely arbitrary and has to be memorized in order mentally to grasp the type. Then they take each differing lot of engines and give them numerical designations, adding these to the type-letters. Thus they have "A–1," "A–2," "A–3," etc., to show different groups of "A" engines. This is further extended by suffixing a letter for subsequent additions to any class where there are relatively slight changes. For instance, "D–13" class gets an addition of some engines with a slightly differ-

ent diameter of wheels, but with no other important change, and they would be designated "D–13–a;" the suffix being changed to "b" on the next revision. Many railroads do not endeavor to show the type in their motive-power classification symbols, but use letters or numbers, singly or in combination. There are not enough letters in the alphabet to show all the classes on some roads.

The Rock Island System uses a numerical motive-power classification—1, 2, 3, 4, etc.—adding a sub-letter for modified classes—"4–A," "4–B," "4–C," for instance, being successive modifications of Class 4. The majority of repair parts are common to all. This system is also arbitrary and gives no clue to the uninitiated as to what kind or size of engine is in each class.

The so-called "Whyte classification" gives successively the number of wheels in the truck, drivers, and trailer, as, e. g., "2–6–0," "4–4–2," etc. This system is convenient in some ways, and is used by the American Locomotive Company, and others, the total weight of the engine in thousands of pounds being added. Thus, "4–6–0–180" expresses a ten-wheel engine weighing 180,000 pounds.

At a Master Mechanics' Association convention a few years ago, it was proposed by Mr. R. P. C. Sanderson to classify engines by suggestive letters—as "T" for ten-wheel, "C" for consolidation, etc.—adding a number to show the thousands of pounds of tractive power, or the percentage of 100,000 pounds. Thus, "T–30" would be a ten-wheeler of approximately 30.-000 pounds' tractive power. This system possesses

considerable merit, the simple symbol conveying a definite idea as to the type and power of the engine. There are, however, about thirty-five possible wheel arrangements, and it is not always feasible to pick out suggestive letters.

This and the Whyte systems cannot be used as Motive Power Department classifications, as particular groups or individual engines cannot be identified. To illustrate, suppose an order is received for a back cylinder head for a "4–4–0" engine or for a "T–30" engine. The "4–4–0" symbol covers every eight-wheel engine on the road of all sizes and makes, and the "T–30" may include a number of lots on which the details are not similar. It is therefore necessary to have a distinctive motive-power class designation, in order to make proper records, orders, and statistics. It is not likely, however, that a common system will ever be used by all roads which now differ. To make such a change would involve much trouble in fixing up historical, pattern, and drawing records, and in establishing the terms of the new classification in the minds of all concerned.

Some roads do not even have a distinctive classification, but refer to the engines by numbers or series, as the "400 class," etc. This is not a good practice, as the records get woefully mixed up when engine numbers are changed, which is often the case with a growing system. On a large railway system the number of motive-power classes is necessarily large and beyond the capacity of retention of any ordinary memory. In the Motive Power Department of the Rock Island sys-

tem we do not find this an embarrassment, as we have aids for the memory in registers and equipment books and lists.

Other departments, however, are not interested in many of the minor differences between various lots of engines, which may be of the same type and similar hauling capacity. For these departments a classification giving one symbol for all engines similar in type and power is desirable, so as not to burden them with the minute details of the motive-power classification. Such a classification may be called a "road" classification, in distinction from the other. One having a letter indicating the type, and a numeral showing the thousands of pounds of tractive power, is convenient and useful. As these symbols are sometimes used over the wires, the letters must be chosen with reference to easy telegraphing with the numbers. The letters in use on the Rock Island System are as follows: simple engines —eight-wheel, "B;" ten-wheel, "D;" "Consolidation," "C;" "Atlantic," "A;" "Pacific," "N;" "Mogul," "G;" "Suburban," "K;" four-wheel switch, "H;" six-wheel switch, "J;" compound engines—ten-wheel, "F;" "Consolidation," "Q;" "Atlantic," "W." Thus, we have eight-wheel engines from 10,000 to 19,000 pounds' tractive power, expressed as "B–10," "B–11," "B–12," etc., up to "B–19;" ten-wheel engines, from "D–14" "D–31;" "Consolidations," from "C–25" to "C–40."

When once comprehended, this symbol gives a relative idea of the type and power of the engines; and this is mainly what the transportation people want. If they want to know the size of wheels or the tank

capacity, or to obtain other special information, it is readily available from the equipment books and lists. If a new engine comes on a division, its tonnage capacity is known at once by the road class numeral. Our tonnage rating-books for each division have columns headed by numbers—10, 11, 12, etc., up to our highest tractive-power symbol—and by having each engine marked and recorded, tonnage ratings can be assigned without delay or calculation.

II. TYPES OF LOCOMOTIVES

Having now disposed of classification, we will consider types of locomotives. The simplest wheel arrangements are those of switching engines. These generally have six wheels, although there are many old four-wheel and a few modern eight-wheel engines. These engines have to go around sharp curvature into industrials tracks, and modern six-wheel switchers are built with a wheel base not exceeding eleven feet, while the four-wheelers average about seven feet six inches. The eight-wheel switchers are used only in heavy classification yards, where it is advisable to have switching engines heavy enough to handle singly any train that may come in or be made up to go out, for distribution, weighing, or setting.

These switching engines, according to the Whyte system, are 0–4–0, 0–6–0, or 0–8–0, depending on the number of wheels. The entire weight of the engine is available for adhesion, and six-wheel switchers run generally from 90,000 to 150,000 pounds' weight. Besides switching engines, about the only other type, used

in this country, that does not employ a leading-truck is the "Forney" engine, used principally for light elevated and suburban service, where an engine should run equally well in either direction. The "Forneys" have two or three pairs of drivers, with four or six wheels carrying the tender portion of the engine, which is on an extension of the main frames. The Whyte classification for these is 0–4–4, 0–6–4, 0–4–6, or 0–6–6, and they are called "four-coupled" or "six-coupled Forneys," as indicated by the drivers.

Many "double-enders," as engines to run in both directions are called, have a two-wheeled leading-truck, and are named "four-" or "six-coupled double-enders," as the case may be. They are expressed by the Whyte symbols as 2–4–4, 2–6–4, 2–4–6, or 2–6–6. It would be possible to build a 2–8–6, but that is hardly desirable. The Rock Island has some 2–6–6 engines with 107,000 pounds on drivers, and a total weight, in working order, of 194,700 pounds; but these are exceeded by the New York Central engines of the same type, with 128,000 on drivers, and a total weight of 214,000 pounds. The Illinois Central employs forty engines in its Chicago suburban service, with the following wheel arrangements: 2–4–4, 2–4–6, 2–6–4, and 4–6–4. The use of four-wheel leading-trucks on this type of engine is not common, but it is possible to make the following combinations: 4–4–4, 4–6–4, 4–4–6, and 4–6–6. These engines have a limited coal and water capacity. For a general summary of information regarding engines of this class reference may be made to an article on "Tank Locomotives," by Mr. E. E. R. Tratman in the *En-*

gineering News, for February 16, 1905; also a paper, with the same title, read at the last meeting of the Western Railway Club.

Taking up the other classes having a two-wheeled leading-truck, but no trailer, we have the 2–4–0, built only for light service, contractors' use, etc., and called a "four-coupled engine." Next is the "Mogul" type, having a 2–6–0 arrangement of wheels. This type is not now so extensively built, although a great favorite on many roads. It is hard on the track when very heavy, and in some quarters is regarded with suspicion as prone to derailment. On the other hand, the Chicago, Burlington & Quincy Railroad is noted as a successful user of the "Mogul" type in very fast service. The formula of the American Locomotive Company for the proper length of the radius bar of two-wheel trucks may be of interest and value in investigations of "Mogul" trucks. It is as follows: $\mathrm{R} = \frac{A \times B}{A + B} \times .85$, where $A =$ the distance from the truck to the farthest driver, $B =$ the distance from the truck to the nearest driver, and $R =$ the radius intersecting the truck axle center line on the horizontal center line of the engine.

The remaining types of this group are the 2–8–0 and the 2–10–0, named, respectively, the "Consolidation" and the "Decapod" types. The "Consolidation" is a favorite type for heavy freight service. When of medium weight, it is very easy on the track, and a large percentage of the weight is available for adhesion. The heaviest "Consolidation" of which I have record is an engine on the Pittsburg & Lake Erie Railway,

with 225,000 pounds on the drivers. The Rock Island has 100 "Consolidation" engines with 180,000 pounds on drivers. But I believe that for a general all-around engine, for the average western track, 160,000 pounds would be a better figure. The "Decapods" have an additional pair of drivers, and are used mainly on heavy mountain grades and in pusher service.

We will now consider the groups with four-wheel leading-trucks and various driver arrangements. First is the 4-4-0, the so-called "American" type or eight-wheeler—the pioneer and best known of the older engines, which has brought about the greatness of the American railway systems. Old runners wish that nothing else had ever been invented. One hundred thousand pounds is about the limit on the drivers, and the great majority run far below that. Not many are now being built; but we shall have to have them, and light ten-wheelers, for many a day on branch-line service. Next comes the 4-6-0, or ten-wheeler—a design very extensively built, with from 100,000 to 140,000 pounds on drivers. Many roads do not have any heavier types than this, believing it best adapted to business such as we have in the Middle West, with moderate gradients, a large proportion of the traffic being fast freight and stock movement. If we add another pair of drivers to this type, we have the 4-8-0, or twelve-wheeler; and, if still another, the 4-10-0, or "Mastodon." These latter types are not common, being used mainly for mountain service.

The next groups comprise various driver arrangements with two-wheel trucks leading and trailing.

Trailing-trucks are comparatively new in American railway practice, having been introduced to meet the necessity of supporting the back end of fire-boxes wider than would go between driving-wheels. The 2–4–2, or "Columbia," type has been tried, but has not proved very successful. The 2–6–2, or "Prairie," type originated in the West, as its name indicates, and adds a trailer to the "Mogul" type, permitting a shorter, wider fire-box. The 2–8–2, or "Mikado," type adds a trailer to the "Consolidation;" and the 2–10–2 is the "Mountaineer," for special service.

The next group employs a trailer for the same object as the preceding, but with a four-wheel leading-truck. The first type is the 4–2–2, or "single-driver," engine. Very few of these have been built in this country, but they can be found abroad. The 4–4–2 is our familiar friend, the eight-wheeler with a trailer, now called the "Atlantic" type. The increased fire-box area makes this a favorite engine for heavy, fast passenger service on low-grade lines. It is the most expensive engine in the proportion of total weight to tractive effort, as but one-half its weight is available for adhesion. If we add a trailer to carry a wide fire-box of a ten-wheeler, we have the 4–6–2, or "Pacific," type—a comparatively new one, but finding favor in heavy, fast passenger work on grades. This type has the disadvantage of requiring very long tubes—twenty feet in some cases. Length of tubes is of no advantage for heating surface in this case, and the spaces or bridges between the tubes have to be increased, lessening their number. The Pacific type makes up for this by the increased fire-box

and grate surfaces, so that the difficulties named are not vital, although more trouble is experienced in caring for long tubes than for shorter ones.

It will be noted that most of these developments have been brought about by the demands for steam, to accommodate additional boiler capacity. Years ago the fire-boxes were deep, down between the frames and between the axles, with a grate surface about thirty-three inches wide. Gradually the length was increased until the side-rods got pretty long and the rigid wheel base more than was desirable. Then the water legs were shortened, permitting the axles to run under the fire-box. Later the fire-box was put on top of the frames, permitting the widening of them to take a grate forty-two inches wide. This has been very extensively practiced; but, even with this width, the demand for grate surface has been such as to make the boxes nine and ten feet long, and rather difficult to fire. This has resulted in spreading the fire-boxes out over the back drivers, when of moderate size; and in order to keep the front ends down so as to have some depth below the bottom rows of tubes, many engines have a hump or break in the line of the grates, which is difficult to keep covered in firing. The tendency of late has been to get the fire-box back of the drivers and support it with a trailing truck, as noticed in the various types mentioned. A width of box of about sixty-six inches is employed, which can be readily fired from one door, and the length can be made to suit the capacity desired. In the East, where suitable fuel is found, there are a great many Wooten boilers used. These are of extreme

width, and the construction necessitates separating the runner and the fireman. They are not used to a great extent in the West.

The demands on present-day locomotives for speed and hauling capacity has made the question of boiler development pre-eminently important; for, no matter how fine the engine may be, it is impotent unless unfailingly supplied with steam. There are heavy demands for steam on locomotive boilers for other purposes than for use in the cylinders. The length of trains has increased so that much larger air-pumps are in use than formerly; and the air is used, not only for brakes, but for forcing water, for bell-ringers, sanders, door-openers, etc. Steam is used for heating trains, and the demand on long trains in sub-zero weather is very heavy. Electric headlights are run by steam turbine engines and on some trains the electric-light machinery for car illumination is supplied with steam from the long-suffering locomotive boiler. Tender tanks must be kept from freezing up; and the various leaks from the multitudinous joints of the boiler and steam passages add their quota of demand. It is not surprising, therefore, that an entire change has been accomplished in boiler dimensions, and the ratios of boiler power to cylinder capacity have been greatly increased in modern practice. We often think that we have reached the limit, only to find a new development that soon becomes commonplace.

We have outstripped our brethren across the water in the weight and power of locomotives, but we have much to learn from them about the refinements and

economies which we have sacrificed in the making and using of steam, due to the demands upon us for speed and power, in such a short time for development. I can remember the wood-burners with their balloon stacks, pumps operated from cross-heads, lubrication of cylinders from tallow cups on the steam-chests, hand-brakes, and all those things that are now looked upon as antiquities; and I am not looking back more than forty years. Neither were there any telephones, or electric lights and traction, in those days. We are living in a rapid age, and who can predict the types of locomotives that will be in common use forty years hence? The electrical engineer began prophesying, some years ago, about steam locomotives soon becoming museum relics; yet there is one concern, in Philadelphia, that is turning out over fifty of these relics every week, and its order-books are full for months in advance. The combined weight of those fifty machines would probably make a hundred engines of the types of twenty years ago. Electric traction will, no doubt, come more into play in the near future, in competition with steam railways, where there is a dense traffic. Already New York has decreed that steam locomotives must not much longer enter her boundaries, and the railways there are preparing for electrification. Travel through the tunnels at Baltimore has been made more endurable to passengers and employees by electric locomotives. The St. Clair tunnel, with its 2 per cent. grade is considering the electrical proposition.

Busy electric suburban lines are teaching the steam roads that frequent service increases travel, and it be-

hooves every one in present or prospective railway service to become acquainted with electrical engineering as applied to traction, power and lighting. There is no mystery about it. It is nearly all mechanical, after all; we merely move into another field of application, and our opportunities are broadened.

It is the spirit of our times. The corner fruit-stores of a few years ago—what was their stock compared with what we see now of fruits and delicacies from all over the world? What was the product of the printing-press, only a few years ago, as compared with the present-day output of books, magazines, periodicals, and newspapers? What of the educational opportunities of today, as compared with those our fathers and grandfathers enjoyed? All this, it may be thought, has no reference to types of locomotives; but we are trying to gain knowledge in railroading, and I wish to impress the necessity and desirability of taking the broad view, of embracing the large present opportunities for gaining knowledge in so many directions that may, some day, evolve a new type or modification—perhaps only a small detail. But, whether ten or five or only one talent be gained, we shall have the satisfaction of knowing that our labor has not been in vain; and that satisfaction is a large portion of the reward.

THE COMPOUND LOCOMOTIVE

W. R. MCKEEN, JR., SUPERINTENDENT OF MOTIVE POWER AND MACHINERY, UNION PACIFIC RAILROAD

A brief history of the early development of the steam locomotive will serve as an introduction to the subject. The ancients apparently were imbued with a conception of the value of steam as a motive power. The philosopher Hero is said to have demonstrated its power about 130 B. C. He wrote a treatise explaining how the expansive force of steam might be utilized by means of cylinders, valves, pistons, etc.; and the old woodcut illustrations of Hero's engine, with its revolving globe and reaction tubes, are familiar to many. Hero's device was followed in time by others, representing more or less advance in thought, but all lacking the essential and practical features necessary to use in everyday life. Coming down to the eighteenth century, it is said that a Dr. Robinson suggested, in 1759, the use of steam to propel wagons or carriages upon the public highways. Following his suggestions, models were made by James Watt. In 1769 and 1771 other machines were made. These in turn were followed by many others, of various designs. Defects in theory and application, coupled with excessive cost of operation and the poor roads of that day, prevented any of these engines from becoming of practical use.

In the year 1800 Trevithick invented a machine which, though but a toy making its first journey on the

kitchen table, represents the birth of the successful locomotive. Three years later Trevithick devised his first practical locomotive, and built one for use on the railroad or tramway of that time. It was successful in all respects save cost of operation—being more expensive than the use of horse-power—and therefore was not given extended use. This objection was overcome in 1811 by John Blenkinsop, who built two locomotives for use in Middleton Colliery, of which he was proprietor.

Following these inventions, George Stephenson, in 1814, placed in operation his first locomotive, the "Blucher." Thus this great man, who is reputed to be the father of the locomotive, in reality only carried out an idea discovered eleven years before.

The evolution of the locomotive since these early days has, without exception, been the greatest mechanical factor of our rapid growth and latter-day civilization.

Until within comparatively recent years, the aim of designers was along the lines of increasing the general efficiency of the steam locomotive by perfecting the design of boiler and machinery, meeting, at the same time, the increased requirements of heavier traffic. Numerous types were designed and built, including every conceivable combination and arrangement of cylinders, wheel-base, method of transmitting power from the cylinders to the wheels, valve motions, types of boilers, manner of combustion, etc.; out of which were gradually evolved a few recognized standard and efficient types. And it may be stated that all designers had

reached practically the same uniform types, as well as the same degree of efficiency in the performance of their various locomotives. It was recognized that a limit of efficiency was being approached, and, outside of certain refinements of details and enlargement of design to suit increased traffic demands, there seemed no probability of improvement.

At about the same period the benefits to be derived from the use of steam of higher pressures and successive expansions in different cylinders—the same as in marine and stationary service—began to exert their influence upon the minds of those interested in the problem of economics in locomotive operation. In marine and stationary practice, engineers had been able to effect savings ranging from 15 to as high as 40, and even 50 per cent., based upon the performance of their old single-expansion engines; why, then, could not these economies be effected, if the mechanical difficulties could be surmounted, in locomotive practice?

It is true that in this field, as in others, sporadic attempts had already been made in this direction. The first designer successfully to apply the compound principle to the locomotive was A. Mallet, a Frenchman, who in 1877 built several compound engines of the two-cylinder type, with starting arrangement for admitting steam directly to low-pressure cylinders. It was, however, not until twelve years later, or in 1889, that the compound principle was applied to locomotives in this country. In that year the Baltimore & Ohio Railroad put into service an eight-wheel compound engine of the "Vauclain" four-cylinder type. At this time there had

been one thousand compound locomotives built in Europe, showing that the principle had been developed to a considerable degree before the designers of this country took hold of the idea. Since 1889, however, the growth of the compound locomotive has been rapid, numerous forms have been built and successfully operated, and it may be assumed that today there are five thousand compound locomotives running in the United States. It will be necessary here to confine ourselves to the comparatively few modern types of locomotives which have been successful.

As the parent of all locomotives, credit should be given to the eight-wheel American engine, which has done more in the development of this country than any other type. This engine was developed in 1836, and, until the last decade, remained the standard type for passenger service throughout the country. It has practically given way, in the last ten years, to the more powerful "Atlantic" type engine, with its larger boiler and cylinder capacity, and greater ability to reach and sustain high speeds with moderately heavy trains.

The load which a locomotive can pull—that is, its hauling capacity—is approximately one-fifth of the weight on the drivers. For practical reasons—such as the safety of the track, bridges, etc.—it is not advisable to load one pair of drivers with more than 50,000 pounds, although this limit is sometimes slightly exceeded. It therefore follows that with any type of locomotive having but two pairs of drivers—such as the eight-wheel "American" and "Atlantic" types—we soon reach a maximum of hauling capacity, and the

limit for this design of engine. We logically pass from the eight-wheel type to the ten-wheel type—likewise, from the "Atlantic" type to the "Pacific" type—by the addition of another pair of drivers, enabling us to increase the total weight on the drivers, and, hence, the hauling capacity of the engine. The demands for the transportation of heavier trains led our designers to the construction of these heavier types—namely, the ten-wheel, "Pacific" and "Prairie"—which, with the "Atlantic" type for lighter service, represent the typical engines in passenger service today.

Let us now look at the other branch of transportation—freight service—and examine the types which here are in vogue. The remarks in regard to weight on drivers necessary to pull a certain load are equally applicable to both services.

In the early days the accepted type of freight engine was usually a six-coupled, or three-pair-drivered, engine, with either a two-wheel swivel truck or a four-wheel rigid truck; the former being known as the "Mogul" type, and the latter as the "Ten-Wheel" type. As the traffic demands increased, a heavier engine became necessary; the natural result being a four-pair-drivered engine with a two-wheel truck—termed a "Consolidation" engine. Although still heavier types, such as the "Decapod" and "Santa Fé" (with five pairs of drivers), are built for particularly heavy service conditions, we may safely say that the "Mogul," "Ten-Wheel," and "Consolidation" are the three representative types of freight locomotives today.

In addition to the classes already spoken of as repre-

sentative types, there are a few recognized types of locomotives for special service. Foremost among these are the several designs of switch-engines, with two, three, and even four pairs of drivers, with all the weight resting on these drivers, and without any form of truck. As the service of this class of locomotives is intermittent, larger cylinders in proportion to boiler capacity may be used, with the attendant advantage of great starting power.

For excessive grades the rack-rail engine is a recognized type; while the "Shay" engine, with its bevel-gear drive, is a type for heavy grades, and may be said to be an intermediate design between the rack-rail and the ordinary traction types.

As previously stated, the first type of compound engine to appear in France, was the two cylinder machine invented by Mallet in 1877. This construction necessarily implies one high-pressure and one low-pressure cylinder. The usual arrangement with two cylinders consists in placing the high-pressure cylinder on one side, and the low-pressure cylinder on the other side, of the engine. This is called the "Two-Cylinder" or "Cross Compound" engine. The high-pressure cylinder takes its steam directly from the boiler. Through the instrumentality of its valve, the steam supply is cut off at about half-stroke, expands to nearly the end of stroke, and exhausts into a receiver at a considerably lower pressure, having done a certain amount of useful work in expanding against the high-pressure piston (in the receiver the steam receives an additional amount of heat). The steam remains but momentarily

in the receiver, when another valve admits it into the low-pressure cylinder, where the piston has approximately two and one-half times the area of the high-pressure piston. Here it undergoes another expansion, and thence exhausts through the stack into the atmosphere at a low pressure, usually of from about 17 to 20 pounds, having done additional useful work. Keeping in mind that steam at 200 pounds' pressure has a temperature of about 387 degrees Fahrenheit, while at 17 to 20 pounds' pressure its temperature falls to 254 degrees—or a range of 133 degrees—it will be seen that, by carrying the expansion out in two different stages and in two different cylinders, the range or drop in temperature in each cylinder is about half what it would have been had the entire expansion taken place in one cylinder. This prevents the hot steam, when entering the cylinders, from meeting cylinder walls of very much lower temperature, caused by the outgoing cooler steam; and thus the initial condensation, which is the worst factor to contend with in single-expansion engines, is materially decreased. Since the adoption of the higher steam pressures, ranging from 200 to 220 pounds, with their attendant higher temperatures, this factor of initial condensation has become much more important than in earlier days, when such pressures did not exceed 130 pounds. In other words, the use of compound cylinders permits of the use of a wider range of expansion, without the attendant evil of excessive condensation.

Such, then, is the theory of the compound locomotive. I have purposely described the simplest method

of compounding—namely, the cross compound—in illustrating this theory. This type has been in successful use on a number of roads in the United States, in both freight and passenger service. The proportion of work between the two cylinders can easily be adjusted by a proper arrangement of the steam-chest valves, and the number of parts is reduced to a minimum, which is an important item in the cost of repairs.

The cross compound, however, has its limitations, as, in attempting to increase the power of the engine beyond certain limits, the diameter of the low-pressure cylinder becomes so excessive that it extends beyond the clearance lines of most railroads. As the locomotive needs its maximum power when starting, and as the low-pressure cylinder must wait until the high-pressure cylinder has exhausted into it before it can generate its share of power, it is necessary to provide some method of admitting steam from the boiler directly into the low-pressure cylinder of the first few revolutions. Again, in order to augment the power of compound locomotives, when starting heavy loads, or approaching the top of a heavy grade at slow speed with a heavy train, it is desirable to transform the compound locomotive, for the time being, into a two-cylinder simple engine. This is accomplished by introducing steam from the boiler directly into both high- and low-pressure cylinders, and arranging so that both will exhaust directly into the atmosphere. These requirements are fulfilled by the "intercepting valve," which controls the movement of the steam. When the engineer turns the operating valve in his cab to simple position,

a spring closes this valve, and the steam cannot then pass from the high-pressure cylinder into the low-pressure; the steam that has entered the former cylinder exhausts directly into the atmosphere. At the same time, the live steam opens a small reducing valve and finds its way through the receiver into the low-pressure cylinder. The reducing valve is so constructed that the total pressure on the low-pressure piston equals that on the high-pressure piston when working simple. This balances the power effective on the two sides of the locomotive, and consequently produces smoother and more satisfactory running.

Another type of compound which has met with much success in both passenger and freight service, and which is largely used in the United States, is popularly known as the "Vauclain" compound. Briefly described, it consists of four cylinders, two on each side, one above the other; and on each side one of the cylinders is a high-pressure and the other a low-pressure cylinder, this giving a complete compound unit on each side of the engine. Each high-pressure and low-pressure cylinder combination is governed by a piston valve, which effects the entire distribution of steam from the time it enters the high-pressure cylinder until it leaves the low-pressure cylinder as exhaust into the atmosphere. In order to have equal pressures on both upper and lower piston rods, and to prevent undue strains on the crosshead, it is necessary to have equal work done in both high-pressure and low-pressure cylinders, or to have the product of the mean effective pressure into the area of the piston in square inches

alike for both cylinders. This is accomplished by adjusting the ratio of the diameters of the two cylinders when designing, and by arranging the piston valve to give a certain cutoff for each cylinder.

Another type of compound, and one that has met with much favor in heavy freight service, is known as the "Tandem Compound," from the fact that on each side of the locomotive are placed two cylinders on the same axis, one in front of the other, the high-pressure cylinder being placed ahead of the low-pressure one, and the two pistons being mounted upon the same piston rod, which extends through both cylinders. Each cylinder is actuated by a separate valve, both valves being driven by the same valve-stem. The peculiar feature of the "Tandem Compound," is that the steam exhausts from the front end of the high-pressure cylinder to the back end of the low-pressure cylinder, and vice versa.

Turning our attention to Europe, we find several distinctive types of compounds. In England the "Webb" compound, employing three cylinders, one high-pressure and two low-pressure, is the prevailing type. In France, the "De Glehn" compound has acquired special prominence, being the prototype of the many recent designs at home and abroad of that popular locomotive known as the "Four-Cylinder Balanced Compound." The De Glehn type has four cylinders in a horizontal plane, the two high-pressure cylinders being outside, and the two low-pressure cylinders inside, of the frames. Four separate slide-valves are employed, each with separate valve-gear (which is the Walschaert

type modified), and two reverse levers are used to modify the cutoffs of high- and low-pressure cylinders independently. The outside, or high-pressure, cylinders are connected with the rear drivers, while the inside, or low-pressure, cylinders are attached to the front axle, which is a crank axle. In Germany, von Borries has developed a four-cylinder balanced compound locomotive which has the high-pressure cylinders inside and the low-pressure cylinders outside of the frames—or the reverse of the De Glehn type; and, furthermore, the two high-pressure cylinders are located somewhat back of the low-pressure ones. Four separate valves are used—piston valves for the high-pressure, and slide valves for the low-pressure, cylinders. The Walschaert valve-gear, modified, is used. In this type of balanced compound the outside, or low-pressure, cylinders are connected with the front drivers, and the inside, or high-pressure cylinders, are connected with the same front axle, which is a crank axle. Thus all four cylinders drive the front pair of wheels, while in the De Glehn type the forces are distributed between two pairs of wheels.

In the United States several types of balanced compounds have been developed. The "Vauclain" four-cylinder balanced compound employs four cylinders in a horizontal plane, with the two high-pressure cylinders inside, and the two low-pressure cylinders outside of the frames, while a single piston valve is made to serve both the high- and low-pressure cylinders. These valves are driven by the usual Stephenson link motion used on simple engines, and one reverse lever is used.

Both methods of connecting cylinders to axles are employed; namely, all four cylinders to the front axle; or the inside cylinders to the front or crank axle, and the outside cylinders to the second pair of wheels.

The "Cole," compound engine, used by the New York Central Railroad, and designed by the American Locomotive Company at Schenectady, employs four cylinders in the same horizontal plane, but the inside, or high-pressure, cylinders are ahead of the outside, or low-pressure, cylinders, so that a tandem valve-rigging may be used; and each valve-stem carries two separate piston valves—the rear one for the low-pressure and the front one for the high-pressure cylinder. The Stephenson link is thus applicable to four separate valves, and one reverse lever is used. The cylinders are connected as in the De Glehn type—outside to the rear driver, and inside to the front or crank axle.

One of the most interesting types of compound, and one recently adopted, for the first time in this country, by the Baltimore & Ohio, is the "Mallet Articulated" compound for heavy freight service. In this type the high-pressure cylinders work the rigid engine, while the low-pressure cylinders work the flexible engine.

I have already mentioned the benefits to be derived by compounding in locomotive practice, calling attention to the more economical use of the steam. Each pound of water in a given type of boiler requires for its transmission into steam at boiler pressure a definite and fixed amount of heat energy, which, with coal of a given quality, means a definite amount of coal consumed, or a definite price per unit of coal, or per pound

of steam produced. This being true, it follows that any arrangement at the cylinders which effects an economy in the use of the steam reacts directly upon the earnings and profits of the road. So many comparative tests have been made throughout the country between simple and compound locomotives, to ascertain the economy of the latter over the former, that I hesitate to choose or allude to any particular test; but it is sufficiently accurate to state that the fair average saving of the compound over the simple locomotive may be 20 per cent., or one-fifth of the fuel used. Some types of simple cylinders, owing to faulty design, are more wasteful than others, for a similar reason; hence, trials have been made where the compound has shown an economy of as high as 33 per cent., as in the case of a test made in 1898, by Professor Richard Smart, M.E., at Purdue University.

Not only does the compound cylinder effect a direct economy of steam used, and a consequent saving of coal, but, in addition to this, there is another economy of coal, due to the fact that the lighter exhaust of the low-pressure steam from the compound cylinders causes the boiler to generate its steam under a lighter draft; hence the boiler is not forced to so high a point of evaporation.

In addition to the matter of fuel and water economy of an engine, the question of the cost of repairs, or maintenance, must be considered. If there is to be an increase in the cost of maintenance with the compound engine, it will undoubtedly come from the cylinders and connected parts; while, if there is to be a saving,

it will be in the decreased cost of maintenance of the boiler. The average cost of maintenance of cylinders and connected parts is about 3 per cent. of the total cost of repairs, while for the boiler it amounts to about 30 per cent. Any small saving, therefore, on boiler repairs will more than offset any increase in the cost of the cylinder repairs.

By no means the least advantage of the compound engine is the greater immunity from fires along the right of way, with their attendant losses, which on many roads aggregate thousands of dollars annually. With large-sized simple engines the exhaust is made at high pressure, the draft on the fire is severe, and in consequence more or less fire is thrown from their stacks. The compound exhausts at a lower pressure through a larger opening, and the throwing of fire is reduced to a minimum.

The weight of a freight train which an engine can successfully haul over the road depends upon the number of cars that can be taken over the heaviest, or ruling, grade. If it were not for this ruling grade, frequently 10 or 15 per cent. more tonnage could be taken over the remainder of the division. With the compound locomotive, when there is a hard pull on a ruling grade, the tractive power of the engine may be temporarily increased by admitting a certain amount of steam directly from the boiler into the low-pressure cylinder, until the top of the grade is reached—an advantage not attainable with simple cylinders.

The compound freight engine develops its maximum efficiency and fuel economy when working under a

maximum load; the single-expansion engine, on the contrary, develops its minimum economy when working under a maximum load. On the other hand, the compound engine develops its minimum economy with a minimum load, such as on a descending grade or with a light train-load; whereas the simple engine develops its maximum economy on a descending grade, or with a light train-load. This feature is highly appreciated by the locomotive fireman, whose task on a single-expansion freight engine, under a heavy train-load or on steep grades, is very severe and laborious; and the success of a locomotive in hauling a train over the summit of a hill is often directly dependent on the ability of the fireman to feed the requisite amount of coal into the fire-box in a given time. With the compound, on a heavy grade, the fireman's task is from 30 to 40 per cent. less, or easier.

The compound locomotive, beyond question, is not economical on descending grades, owing to the back pressure generated in the cylinders by the piston action. Excessive back pressure in the cylinders develops pounding of the machinery, rods, etc.; and, to avoid this, a limited amount of steam must be worked through the cylinders. This steam, of course, costs money to generate, and is of no practical value in pulling the train, except as a remedy for the evil of back pressure.

The success and economy to be obtained with a compound engine are often frustrated by the ill proportion of the drivers to the service or road requirements. Other things being equal, "the slower the piston speed, the greater the economy," is true within

reasonable limits; and, roughly speaking, a compound engine should have at least a twelve-inch larger driver than a single-expansion engine of the same capacity on similar road service.

The ease with which a heavy train can be started without shock by a compound locomotive is a considerable advantage over the ordinary single-expansion engine. A skilful, experienced engineer can stop a long freight train, as well as a passenger train, by means of the old-style three-way cock. It was the inexpert engineers who showed the necessity for the improved equalizing and discharge engineer's brake-valve. This improved valve enables the inexperienced engineer to handle the air-brake successfully and efficiently. The same principle holds with reference to the compound engine versus the simple. Expert engineers, both on passenger and on freight engines, are able with a reasonable tonnage to utilize the expansive properties of steam, and in special cases obtain some very fair economical results; but the majority of engineers devote a very limited amount of thought and care in striving for economical fuel results with their locomotives. Furthermore, many enginemen have been found so deficient in the handling of passenger engines as to necessitate their being barred out of this service. By the very principle of the compound, an engineer's economic efficiency is of secondary importance, after the first few revolutions of the drivers. The steam, by means of the valve and the machinery, is worked expansively, and, as soon as the train gains normal speed, the position of the reverse lever on the quadrant

is almost fixed, which allows the speed of the train to be governed entirely by the throttle. Many of our notably unsuccessful engineers on simple engines are giving as good results in handling compounds as our most capable men. Engineers barred out of passenger service, when simple engines were used, have been reinstated, and are successfully and efficiently handling the compounds. It is noticeable that not one engineer has ever been taken out of compound passenger service, except for accident or on account of old age.

A broken packing-ring on a simple engine has caused the engine to give up the train. The same accident might happen on a compound, without the engine losing a minute. A compound engine has been known to lose twenty minutes on a hard run, on account of "no steam;" on examination, seven broken packing-rings were found. On another occasion the piston came loose on the rod, knocking out the cylinder head and breaking a piece out of the cylinder. The engine continued with ten passenger-cars, making up time on the run. An accident of this nature on a simple engine would necessitate the use of another engine; owing to the fact that a large-wheeled passenger simple engine, on one side, experiences great difficulty in starting a train, and in a majority of cases cannot start it at all.

The cost of repairs to cylinders and connected parts has been greatly reduced in my experience by the adoption of an extended piston rod.

CAR CONSTRUCTION

J. H. AMES, CHIEF ENGINEER, AMERICAN CAR AND FOUNDRY COMPANY

The earliest form of the railway was called a "tramway," and was first used in connection with mines and quarries as early as the sixteenth century. The earliest form of railway car, then, was a car similar to those still used in mining, being merely an open box mounted on axles and wheels, and drawn by horses or mules. It was not until 1734 that flanged wheels appeared; and a stone-car built at that time, which was also equipped with a hand-brake, may justly be considered as the prototype of the present-day freight-car.

In 1804 the first cars were hauled by a locomotive. For the transportation of long timbers and bars of iron, cars such as those just mentioned were coupled together by long bars or reaches, and on the center of each car was mounted a bolster, secured by a king bolt, on which the material was loaded. This arrangement contained all the essential features of the modern long-bodied car mounted on trucks, and is still in use in the logging trade. On their first trip these cars carried a load of ten tons of iron bars. This became the standard capacity, which was adhered to for nearly three-quarters of a century, and is still the favored one in England and on the continent of Europe.

While the principle of swiveling trucks was thus early established, for some reason or other it was not

generally adopted, and for many years afterward cars were built with only four wheels, the housings for the axles being either secured to the car frame or held in pedestals. This type of car is still in universal use in all countries except the United States, Canada, and Mexico, where it was discarded at least forty years ago.

The American roadbeds, as a rule, were not as substantially constructed as the European, and the conditions under which they were operated called for a construction of less rigidity than the four-wheeled type, leading to the development of the longer body with two trucks, which will pass more easily around curves, especially those of short radius; and also to the introduction of the truck with a swinging bolster, which makes the car ride more easily when entering or leaving a curve, and relieves the strain upon the flanges of the wheels. It also reduces the tendency of the wheels to climb the rails in passing around curves, and the consequent derailment of the car.

Not long after the adoption of the long car, the capacity was increased from ten to twelve tons; then to fifteen tons. By 1880 the capacity had reached twenty tons, and the length of the car thirty-four feet. This length and capacity remained stationary for some years, when cars of twenty-five tons were introduced. Shortly afterward the capacity was again increased to thirty tons, at which point it remained until 1895, when the increase in the strength of rails and bridges had progressed so that cars of forty tons' capacity could be used. These were shortly followed by cars of fifty

tons. At the present time the majority of cars being built are of these two latter capacities.

With reference to passenger-cars, the car which Stephenson's first locomotive pulled in 1814 was made by taking the body of a four-in-hand stage-coach and mounting it on an underframe fitted with flanged wheels. This served as the model for passenger-cars for many years; in fact, the stage-coach idea is still adhered to in most European countries. The first passenger-coach run regularly for public use—on the Stockton & Darlington road, in 1825—had a door at each end and a row of seats along each side, and therefore may be considered as the prototype of the present American passenger-car. This was, however, soon abandoned for the stage-coach type, which represented the highest development of comfort in traveling up to that time attained.

The first long passenger-cars, with center aisles and end-doors, were constructed in this country in 1833, and this type has been in constant use here ever since. We now know that the present types of American freight- and passenger-cars had their origin in England; but it remained for American railroad men to develop and perfect them, making them the best types for their respective classes of traffic. The early passenger-cars were thirty feet in length. During their evolution into the modern type they have grown to eighty feet, which is the present maximum.

The sleeping-car is a purely American invention, as are also the dining- and mail-cars, all of which are the logical outcome of the longer distances to be cov-

ered in this country than in Europe. The first sleeping-cars were introduced as far back as 1838. The bedding and curtains had to be stowed at one end of the car. Sofas along the side of the car formed the lower berth; a middle berth was hinged to the window-casing; and an upper berth rested on cleats fastened to permanent cross-partitions. It will be seen from this that the arrangement was more in the nature of bunks than of beds. Mr. George M. Pullman's first efforts at improvement were made in 1859, but his early cars were only slightly in advance of others then in use, and it was not until 1863 that the present type of sleeper, known as the "Pullman," was placed in service.

The details of the construction of cars of course have been changed with the increases in capacities and lengths, and I shall mention only a few of the most prominent.

At first there was no standard for the gauge of the tracks among the railroads of this country, which ranged from four feet six inches to six feet. As a result, there was great difficulty in the interchange of cars, when the traffic had increased to the point where this became desirable. As late as 1865, when the first fast freight line was established between New York and Chicago, there were eight railroads over which the cars had to pass, with a maximum variation of one inch in gauge. Hence these cars had to be equipped with wheels having a specially broad tread, in order to ride on the rails of either the widest or the narrowest. Hardly any two roads used the same-sized axle, form of journal-bearing, journal-box, drawbar,

or draft attachments; so that, if any one of these parts required replacement when the car was off its own line, it had been to be sidetracked until the necessary part could be obtained from the road owning the car.

These conditions led to the formation, in 1867, of the Master Car Builders' Association, whose first work was the determination of dimensions for standards for wheel-treads and flanges, gauging-points for pressing wheels on axles, journal-boxes, journal-bearings, and journal-bearing keys; and, later on, of standard contour lines and shanks for automatic couplers, draft attachments, brake-beams, etc. The adoption of these standards by all roads greatly facilitated the movement of cars, and has been an important factor in the building-up of through traffic from one part of the country to another.

The earliest form of car-coupling was a hook, rigidly attached to the car body, and connected with the hooks on adjoining cars by a link. Later on, these hooks were formed on the end of long rods placed below the body-framing, and connected at the center with an elliptic spring, which afterward gave way to a spiral spring. Then the hook was replaced by a cast-iron head through which the rod passed, and was secured by either a head on the rod or a key through it, and the link was secured in the head by dropping a pin through it. This arrangement was superseded by a longer cast-iron head, with a short tail-rod passing through a spiral spring, which bore against iron plates called followers, which in turn bore against castings

or lugs secured to the draft timbers of the car-body. This is the present arrangement, except that the tail-rod has been superseded by a wrought-iron yoke riveted to the shank of the drawbar and passing around the follower plates. The cast-iron link and pin draw-bar have been superseded by the automatic vertical-plane coupler made of malleable iron or steel, which was first introduced for freight-cars about 1887. Prior to the introduction of the automatic coupler there was no standard for the height of the center of the coupler from the top of the rails, making the coupling of cars a difficult and dangerous task, as the variation in height was often as much as four inches, in which case the use of crooked or offset links was a necessity.

The first brake consisted of a wooden block pressed against the tread of one wheel by means of a foot-lever. Then came wooden beams on which wooden blocks were mounted; these beams being connected by a system of levers and rods, which in turn were connected by a chain with a shaft at the end of the car, which was turned by a hand-wheel, by means of which the blocks could be pressed against all four wheels. The wooden blocks gave way to cast-iron blocks with detachable shoes, which could easily be replaced when worn; and later on, with the introduction of air-brakes, the wooden beams were superseded by metal beams of various types of construction.

The single-brake shoe- and foot-lever is still in use on many freight-cars in Europe, and when beams are used with shoes on all four wheels, the brake is set by turning the brake-shaft, as in this country; but, instead

of a chain winding on the shaft, there is a nut, with a trunnion on each side, which rises on the thread cut on the shaft. To the trunnions on the nut are attached links, the other ends of which are connected with a bell-crank, fastened under the end sill of the body, which pulls on the rods and levers. This arrangement is slow in operation, both in setting and in releasing the brakes.

An early form of power-brake was arranged so that the checking of the speed of the locomotive would cause the drawbars to be pushed back, and the yokes containing the drawbar springs would come in contact with bell-cranks connected with the upper end of the brake levers, causing them to move and thus apply the brakes. This type was not used long, as the vacuum-brake soon appeared, and the Westinghouse air-brake was being developed, the first form having been applied in 1869. It was not, however, until after the automatic feature had been introduced, in 1873, that air-brakes came into general use for passenger service; and they were not applied to freight-cars to any extent for more than ten years later.

Up to 1867, when the Miller platform, coupler, and buffer were first applied, the coupling devices for passenger-cars were the same as for freight-cars, with the same amount of slack between the cars; hence in starting and stopping there was the same jerking and bumping that may be experienced on a freight train, to the great discomfort of the passengers. The writer has a very distinct recollection of his first railroad journey in cars that were not equipped with either the Miller plat-

form or the Westinghouse brakes, and words can hardly convey the difference between that ride and one at the present time.

Until 1896, cars were constructed wholly of wood; iron or steel being used only for bolts, frame-rods, truss-rods, and the metal parts of the trucks. Although a number of freight-cars had been built wholly of iron or steel, both in this country and in Europe, as early as 1854, the great increase in cost over wooden cars and the lack of proper machinery for their manufacture prevented their general use. As locomotives were increased in weight and tractive power, and it became possible to haul longer trains, the necessity arose for stronger cars. Many attempts were made by designers to introduce steel center sills in the wooden cars, but these proved unsatisfactory for many reasons. This led to the development of an entire steel underframe, which is an arrangement now coming into very general use. The first all-steel freight-cars for regular traffic were built in 1897 for the Pittsburg, Bessemer & Lake Erie Railroad, being self-clearing hopper cars for the transportation of ore and coal. They were of fifty tons' capacity. Their success attracted the attention of all railroad men and led to their rapid introduction, especially among the eastern coal-roads.

The principal advantage in steel construction, aside from its superiority in strength and durability, lies in the fact that it is possible to haul a greater percentage of revenue-paying load in proportion to the dead weight of the car, which is a non-paying load—or, in other words, an item of the expense of conducting transporta-

tion, as may be seen from the following figures: A wooden coal-car of 44,000 pounds' maximum capacity has a dead weight of about 22,000 pounds, or a ratio of two pounds of paying load to one pound of non-paying load; while a steel coal-car of 110,000 pounds' maximum capacity has a dead weight of 36,500 pounds, or a ratio of three pounds of paying load to one pound of non-paying—an increase of 50 per cent. It is not fair to say that this increase can be obtained in all classes of cars, as box- and other types of closed cars are seldom loaded to their rated capacity, while coal-cars usually are. Much of this increase is due to the fact that the wooden cars were not designed in a scientific way, the thirty-ton car being merely a growth from the ten-ton car, the parts having been increased to meet the additional load and service strains according to the fancy of the Master Car Builder of the road. I have seen box-cars that in the twenty-four-foot–ten-ton stage had but one brace between the transom-post and the door-post. As the cars were lengthened and the distance from transom-post to door-post was increased, the brace was lengthened correspondingly, and made weaker by reason of the length and change in angle; instead of adding another post and brace, which would have given the requisite stiffness. This perhaps is an extreme case, but is cited as an instance of the too frequent lack of care in car design. Another instance is the case of some stock-cars which I saw recently, on which the slats, which are inside of the posts and subject only to pressure from the inside, were each secured to the posts by two bolts. The

braces, which are outside of the slats, and liable to displacement by pressure from the inside, were merely put in place, without cast-shoes at top or bottom, and held by nails through the slats. The result was that, when the nails loosened by reason of the shrinkage of the wood, there was practically nothing to hold them. The lurching of the cattle would push them out, and they would fall off and be lost along the road.

Aside from the parts made standard by the Master Car Builders' Association, there has been no uniformity in car design, each Master Car Builder following his own peculiar ideas. Consequently, as Master Car Builders have changed, so have the designs, with the result that any road that might be named will be found to have cars of the same length and capacity differing radically from each other in details of construction. This necessitates the carrying in stock of castings, forgings, and timbers for each different type of construction, and is a source of expense to the roads, which could have been avoided had a single standard been adhered to.

With the advent of steel cars more attention has been paid to scientific design, and a great improvement has been made in the reduction of weight. There is, however, still a lack of appreciation of the importance of adhering to a single standard, which is more easily obtained in steel than it was in wood; and many railroads are neglecting the opportunity to standardize their equipment when changing from wooden to steel construction.

The use of steel in passenger-car construction is still

in its infancy, being confined mainly to body-bolsters, platforms, and the strengthening of end-frames; but there is a movement in the direction of steel underframes now making itself felt. Steel underframes are being used quite extensively for electric street and interurban cars, and the new underground roads in New York and London are building cars wholly of steel, in order that they may be the strongest obtainable, and also absolutely fire-proof, so that in case of accident the casualties may be reduced to a minimum.

In determining the capacity of a car, consideration should be given to the traffic conditions on the road over which it is to operate, as the maximum load which can be put in the car is governed by the commodity to be handled. For instance, refrigerator-cars cannot be loaded to exceed twenty-five tons with beef or canned meats; therefore it is clearly unnecessary to build a car capable of carrying forty tons. Neither can stock-cars be loaded with cattle to exceed thirty tons. As these two classes of cars handle their special commodities 90 per cent. of the time, why should they be built to carry more, since the larger capacity merely entails a larger first cost, and a daily expense by the cost of handling the extra dead weight? Box-cars, of course, are used for general merchandise, and the average annual loading rarely exceeds fifteen tons per trip. However, if the business consists of handling a large tonnage on short mileage, or transcontinental hauls, a high-capacity car is desirable, as it can be loaded to its full capacity the major part of the year; but for the

middle distances, in local traffic, a car not to exceed thirty tons' capacity will be found best.

In considering the design for a freight-car, two cardinal principles should be observed, viz.: ease in first construction, which will naturally be followed by reduction in first cost; and ease in making repairs, which, of course, means reduction in cost of maintenance. The freight traffic of a rairoad is the backbone of the business, and the freight-cars are the means by which the traffic is handled; therefore it is important that they be in running order as large a proportion of the time as possible, as time lost on repair tracks means not only expense in maintenance, but loss of revenue. It will be found that the simplest designs are the best, and great care should be taken to see that the parts which are subject to shocks—such as the bolsters, draft-rigging, and end-framing—are amply strong, and have a safety factor of at least five.

In cars constructed wholly of wood it will be found that cast steel is the best material for bolsters, permitting them to be made of a single piece; whereas, when built up of plates and castings, the rivets or bolts become loose, permitting them to deflect and come down on the truck side-bearings. The result is that the trucks will not pass easily around curves, producing excessive wear on the flanges of the wheels and the heads of the rails, and increasing the resistance to be overcome by the locomotive, thus causing a greater consumption of fuel.

For wooden cars a good construction for the end-framing is obtained by using steel I-beams for posts,

which should rest in malleable iron pockets firmly secured to the end-sill and end-plate, and the side-framing should be stiffened against bulging from the pressure of a flowing load—such as grain, small sizes of anthracite coal, etc.—by the use of steel angles of Z-bars. The use of pressed-steel carlines or roof-rafters is also a good feature, as there may be a gain in the clear height inside, and stiffness is added to the frame by the carlines acting as cross-ties, thus making it possible to dispense with the use of tie-rods, on which the nuts usually become loose.

As it is an impossibility to obtain seasoned lumber for freight-cars, there is always a shrinkage of the wood, permitting bolts and tie-rods to become loose; hence the whole frame becomes shaky, and the nails in the sheathing and roofing loosen and work out. A new wooden car, if taken into the shop after the first six months' service and given a general tightening-up, will run for several years without further repairs, barring accidents. Unfortunately, however, this is seldom done, and I have seen cars only two to three years old in a deplorable condition, simply from lack of attention. Many thousands of dollars are lost to the railroads of the country annually from such causes as this—a loss which could be avoided by a comparatively small expense.

In steel cars open-hearth steel should always be employed, as Bessemer is not sufficiently homogeneous, and usually contains hard spots in which cracks develop, when subjected to shocks. Steel underframes on freight-cars give fairly good results, but it will be

found that with a wooden superstructure on a steel underframe the shrinkage will permit the superstructure to become loosened, unless the frame-rods are kept tightened; and as the underframe does not shrink or deflect, the upper framing will tip sidewise, since the bracing prevents end motion.

The best form of steel-frame car is that in which there is a steel skeleton superstructure rigidly secured to a steel underframe, with wooden strips bolted to them, to which the wooden floor, lining, roofing, and sheathing can be nailed. Such a car will retain its normal shape under all ordinary conditions, and can be made lighter in dead weight than a steel-underframe car with wooden superstructure.

It has been a much discussed question as to whether cars made of pressed-steel shapes or those made of commercial sizes of plates and structural shapes are the better, and I shall quote the opinion of a pioneer steel-car manufacturer as the best expression on the subject that I have seen:

It is evident that from the very beginning it was recognized that the ideal car would be one made throughout of standard commercial shapes. As pressed steel, however, admitted of the production of shapes of the exact form desired, and the early development of the steel car being in the hands of those predisposed in its favor, and interested in the manufacture of pressed-steel parts, it is natural that great progress was first made in the perfecting of this latter type of construction, while the car made of rolled sections remained for the time in its crude original state, being clumsy and heavy when compared with the more highly developed pressed-steel car.

The advantages of constructing a car from a *few* standard commercial shapes, easily obtained in the open market, especially

when considering the question of repairs, rather than from *numerous* special parts requiring expensive machinery in their manufacture, were too manifest, however, to permit of being long ignored; and that it is possible to build cars from standard rolled sections, having all the advantages of light weight and maximum strength claimed for the pressed-steel car, has been fully demonstrated by the later developments of art, and is amply evidenced by the numerous structural steel cars now in service, which compare favorably with the pressed-steel types in the matter of lightness, strength, and simplicity of construction.

As the strains of service are the same on all cars, irrespective of capacity, the draft-rigging and center sills should be of uniform strength on the highest- and lowest-capacity cars; otherwise the weak car will suffer damage. Undoubtedly some form of anti-friction draft-rigging that will quickly absorb shocks, and not give a heavy recoil as the springs expand, is very desirable; but an entirely satisfactory device of this kind has, I believe, not yet been developed.

As in body construction, so also in truck construction many changes have taken place, numerous special types having been tried and found wanting. The early forms were similar to small four-wheeled cars, consisting of a frame to which pedestals for the journal-boxes were attached, the springs being located between the top of the journal-box and the frame. This type, however, was not sufficiently flexible, nor could a pair of wheels be taken out without first jacking up the car-body, running the truck out, and then jacking up the truck-frame—all of which required time as well as yard room.

About thirty years ago the present style of truck—

known as the "diamond truck," from the shape of the bars forming the side-trusses or frames—came into use, and is now practically the standard type for all American roads. It is easy to build and easy to repair, can be constructed entirely of metal, and is so designed that, if necessary, a pair of wheels can be removed without jacking up either the car-body or the truck-frame. The main point to be observed in designing a truck of this type is to keep the rise of the top arch-bar within the limits of one and a half and three and a half inches, as, if made too high, there is great tendency to buckling between the bolts, the bar being wholly in compression; this also increases the strain on the column bolts, which may be termed the keystone of the side-frame, since, when they fail, the truck goes down.

An attempt was made a few years ago to revive the pedestal type of truck by making it of pressed steel or of structural shapes; and for a time this was quite extensively used in certain portions of the country. But as this style of truck possessed all the disadvantages of the older type, together with some peculiar to itself, it again fell into disfavor, and but very few are now applied under new equipment.

The break-beams should be hung from the truck-frame and not from the body-frame, and should not be suspended from the bolster, but from the column or spring-plank, where they will remain stationary. When hung to any part above the springs, they are subjected to a vertical movement equal to that of the springs, and consequently do not always bear the same position relative to the tread of the wheel. If the

brakes are adjusted when the car is empty and the springs at the highest position, the beam will have to move a greater distance to meet the wheel when the car is loaded and the springs compressed; and this movement, being multiplied through the levers and rods, often results in the maximum piston travel of the brake cylinder being exceeded, rendering the brake ineffective, particularly in case the brake-shoes are worn thin.

Brake-beams should invariably be of metal, as trussed wooden beams are subject to variation from shrinkage and loose nuts on the rods, permitting the beams to deflect, with the same result at the brake cylinder as just mentioned. Metal beams should be of as few parts as possible, those made of five- or six-inch steel I-beams being the best.

Reverting to the bodies of freight-cars: Galvanized iron is the best material for roofs, and is applied in two ways. The first method consists in placing the sheets immediately above the rafters and purlines of the body-framing, and an outside course of boards over the iron. According to the second method, a course of boards is nailed upon the rafters and purlines, and the iron sheets are laid upon these boards. These two methods are known as the "inside" and "outside" method, respectively. Each method has strong advocates, and both have their good points. My personal experience leads me to incline toward the outside roof, because of the ease with which it can be repaired. With the outside roof, however, it is essential for the preservation of the roof that the car-frame be kept well

tightened, as, when the frame becomes loose, its weaving motion when running has a tendency to crack the sheets, if they be too rigidly fastened, by repeatedly bending and straightening at certain points. It is probable that this trouble will disappear with the use of all-steel-frame cars.

Side-doors are a great source of expense and danger, if they be not properly applied. In case they are dislodged from their rails and hang away from the side of the car, they may scratch the varnish and paint from the side of an entire train of passenger-cars in passing; or may catch, and be torn off and destroyed, in passing other freight-cars. If caught in the right way, they may even cause a derailment or wreck of a passing train. Much of this trouble is caused by the use of so-called anti-friction hangers, which, while being easy to operate in a freight-house or on a siding, also easily shift back and forth on the rail when the car is being shunted around the yards, unless the door is closed and locked. This shifting allows the door to hammer continually on the stops, which are loosened and knocked off, permitting the door to run off its rail. The door-hangers also become loosened from the same cause, and eventually the door drops off and is lost. Fixtures can now be obtained which overcome these defects, and their use would be an important item in the reduction of the cost of maintenance.

In passenger-cars safety should be the first consideration, the dead weight being secondary. The introduction of the wide vestibule has been an important factor in the reduction of fatalities in passenger-train

accidents, as it is practically impossible for one car to telescope another when both are equipped with this device. At first, when wooden platform timbers were employed, there was difficulty in carrying the extra weight of the vestibule; but now, with steel I-beams, or channels placed in pairs, for platform members, the difficulty has been overcome. The use of cast steel for body-bolsters has also permitted a more secure fastening for the steel platform, and has reduced the liability to breakage of the longitudinal sills at the point where they cross the bolsters.

Ventilation is an important feature in passenger-car design, and prior to 1860, when the clear story or monitor deck was first introduced in the roof, it was a difficult problem. This mode of ventilation has now been developed to a point where it is possible to obtain a free circulation of air without much danger from drafts. But there is still room for improvement, and this is a subject worthy of further attention.

Heating in the early days was a source of great danger, in case of accident, by the use of ordinary coal-stoves; but this danger has been practically eliminated, first by the introduction of the Baker hot-water heater, and later by the use of steam from the locomotive.

The problem of lighting has likewise passed through several stages of development, including the periods of oil lamps, gas, and electric light. The best practice at present comprises electricity, generated by a dynamo driven by a belt from the car-axle, with storage batteries to supply current when the train comes to a stop, and

with the Pintsch compressed-gas system as an auxiliary in case of the failure of the electrical apparatus.

Great advance has also been made in the interior finish and decoration of passenger-cars. Instead of the heavy carvings and moldings formerly in vogue, which collected and held dust and microbes, and the gaudily painted head-linings, we now have flat surfaces wherever possible, made of carefully selected, finely figured woods, relieved only by inlaid lines or figures—an arrangement allowing of easy cleaning—and head-linings in a single color, preferably a light shade of green, decorated only by a small line or ornamental border in gilt. The entire interior should be harmonious in color, and of such a shade as not to tire the eyes, which would be the case with some colors, or combination of colors, when before the eyes for several hours.

For passenger-cars the pedestal type of truck is still used, but has been greatly improved over the original form. The use of steel-tired wheels, which do not require attention as frequently as the cast-iron wheels used on freight-cars, largely overcomes the objection of difficulty in their replacement. By the introduction of equalizing-bars and the springs which rest on them, great flexibility is obtained, and shocks and movements due to inequalities in the tracks are absorbed before they reach the car-body, making the car ride easily at all times. The frames of these trucks are usually built of wood, plated with steel for additional strength; but trucks built entirely of metal are now in course of development, and will no doubt be in general use

before many years. Many European passenger-cars are still built without trucks, and have either four or six wheels, in the latter case one pair being placed under the center of the car. The difference in the ease of riding is quite marked, as under this system there is a constant vibration of the floor, which, however, is felt only in the feet while they rest on it, but otherwise is not especially noticeable, as the seats are finely upholstered with deep springs in order to absorb the vibration.

In conclusion, I would call attention to the fact that railroad transportation is the greatest industry in the world, and that the cars used in that industry represent an enormous amount of invested capital. It is also true that the freight-cars are apt to receive less careful attention than the passenger-cars or locomotives, notwithstanding the fact that there is a larger sum invested in them than in the others. Let me also emphasize the importance of rational design, mathematically worked out, in order that all parts may be of sufficient strength to bear the shocks incident to the rough service in which the cars are employed, thus keeping the cost of maintenance at a minimum, and enabling them to be engaged in revenue service the maximum amount of time during their life. If this course is pursued, it will be of great assistance to the management in keeping down the ratio of operating expenses to earnings.

DUTIES OF A COMPTROLLER OR CHIEF ACCOUNTING OFFICER

F. NAY, GENERAL AUDITOR, CHICAGO, ROCK ISLAND & PACIFIC RAILWAY

In the early days of railroading the accounts were kept in the offices of the various traffic and operating officials. For example, the freight accounts were frequently kept in the office of the General Freight Agent; the passenger accounts, in the office of the General Passenger Agent; the disbursement accounts, in the office of the Superintendent; and so on. The final results of the accounting in the various offices were forwarded to the Secretary, Treasurer, or some other designated officer, who issued the periodical statements of the operations of the entire road. Under these conditions the accounts were supervised by excellent men, but not by trained accountants. The minds of the various operating officials were filled with matters other than those pertaining to accounting methods; hence the results were unsatisfactory, and frequently large losses of revenue occurred through the laxity of the system. Aside from the loss of revenue, the history of what had been accomplished was imperfectly written, because the statements for the different portions of the railroads operated, and those made by different officers, were compiled with little thought of uniformity, thereby rendering comparisons misleading and of little practical value. Further than this, the various traffic and

operating officials were not always diligent in calling the attention of the executive officer to unfavorable conditions in their own departments. This is an inherent tendency in human nature, however, and not contrary to what might have been expected. Under those methods, one practice, more or less demoralizing, was the collection of perquisites by the various traffic and operating officials—a practice which, it is gratifying to state, is now practically a thing of the past.

This should not be understood as a criticism either of the officers in charge of the departments in which the accounts were handled, or of the clerks, working under them, who compiled the accounts. In fact, those men are to be commended for the degree of success which they achieved under such unfavorable conditions.

Gradually the executive officers felt the need of a central office where the accounts of all departments could be carefully supervised, and compiled by trained men, in order that the revenue of the company might be surrounded with more safeguards, that statistical data or history might be compiled on a uniform basis, and that the attention of the executive officer might be called to unfavorable as well as favorable conditions. Thus it was that, in the progress of the development of the railroad business, there came to be Accountants, Auditors, General Auditors, Comptrollers, etc.—recognized heads of the Accounting Department.

The President and Vice-President, Secretary, and Treasurer of a railroad are always elected by the Board of Directors, but the Chief Accounting Officer is usually appointed either by the President or by the active

executive officer. This Chief Accounting Officer on each road at first had his own individual methods, the methods of different roads being entirely dissimilar, and each man more or less jealous of his own. At the outset some of the operating officers were reluctant to acknowledge the authority of the Chief Accounting Officer, the latter being looked upon as a sort of necessary evil, always intermeddling with the affairs of other people. It is only fair to say that the accounting officers sometimes deserved all of this kind of criticism which they received. At the present day, however, this feeling has been practically eradicated. The up-to-date Chief Accounting Officer sincerely desires to co-operate with every officer of the company, and the other officers recognize the value of earnest co-operation with him, and court it.

Up to about twenty-five years ago each railroad company conducted its business entirely separate and distinct from other railroad companies. It treated other companies, tendering freight traffic for shipment, practically the same as it treated any other shipper, requiring a complete manifest or transcript of the shipments tendered, which was retained in lieu of the shipping ticket covering shipments from business houses; and if a shipment was delivered to another railroad, it required the other road to pay its freight charges at the time of delivery, just as if the shipment were delivered to any other consignee. Passengers were interchanged more freely among railroads by the use of coupon tickets, but each road had its own method of settling with other roads on passenger business so interchanged.

It was found that these methods, especially those applied to freight traffic, were expensive, frequently causing delays and blockades at junction points. Hence through or interline billing was inaugurated—a system which has grown until, at the present time, a very large percentage of the freight interchanged between railroads is handled on single waybills reading from the point of origin to the destination, no matter how many roads handle the shipments. This necessitated uniform accounting methods; and thus the process which brought about uniformity on each individual road now began to operate with regard to interline business among the different roads. This again resulted in the formation of the Association of American Railway Accounting Officers, to which practically every up-to-date Chief Accounting Officer, and many of the subordinate accounting officers, now belong. Through this association, more than through all other agencies combined, uniformity in methods of accounting for interline freight and ticket business, together with uniformity in many other methods, has been established, thus reducing the expense of accounting for interline business to a minimum, facilitating the ready interchange of traffic among railroads, and enabling managers and executive officers to compare the results of their own line with those of other lines.

The interchange of traffic, which brought about the interchange of ideas and formation of the Association of American Railway Accounting Officers, was a very strong factor in broadening the horizon of the Chief

Accounting Officers, and of stimulating them to increase their field of usefulness.

This brief historical outline is necessary to establish a proper understanding of the duties and scope of work of the Chief Accounting Officer of a railroad.

It is believed that, in the ideal organization of the staff of officers of a railroad, the Chief Accounting Officer should be appointed by, and report directly to, the President, or the active operating executive officer,[1] of whose office he should be considered a part. He should be the President's confidential man; which implies that he should be a man in whom the President can place implicit trust. This is important, as it will enable the Chief Accounting Officer to keep in close and intelligent touch with all the transactions of the company, and will frequently result in preventing loss of revenue, and other embarrassments. His authority as to accounting methods should be supreme, but not arbitrary. One railroad President is known to have said that he cheerfully took orders from his General Auditor with regard to the handling of accounts; another, a Vice-President who was the active operating executive, said that his Auditor, as his representative, was entitled to receive all information with regard to the affairs of the company to which he himself was entitled. Thus it will be seen that the Chief Accounting Officer has come to be regarded as a very important factor in connection with railroad operation.

[1] Sometimes it happens that a railroad president is a financier, and the active operation of the property is in charge of a vice-president. To avoid complications, however, for the purpose of this paper it will be assumed that the active executive officer is the president.

The organization of the Accounting Department naturally falls under three heads—receipts, disbursements, and general accounts. These three divisions are sometimes subdivided. For example, receipts are separated into passenger, freight, and miscellaneous revenue, and an officer is placed in charge of each subdivision. The disbursements likewise are sometimes subdivided, though not very often. Some roads have an Auditor of Motive Power Accounts, an Auditor of Maintenance Accounts, and so on; but usually, where a road is large enough to justify a separate disbursement office, the Auditor of Disbursements has charge of that division of the accounting work. Similarly, the general accounts are sometimes subdivided. The titles of the divisions mentioned will readily indicate the class of accounts to be handled by each.

The duties of the Chief Accounting Officer, which will now be briefly considered, may be classified under three headings: (1) properly to safeguard and account for all of the revenue of the company; (2) to present to the President and other officers a true history of what has been accomplished, more or less in detail, according to conditions; (3) to call the attention of the President or other officers to any unfavorable or favorable conditions or circumstances which may come to his knowledge. The detail of work performed by the branches of the department handling receipts and disbursements will not be entered upon here, as it will be treated of in detail by experts who are in daily contact with this side of the work.

I. PROPER SAFEGUARDING AND ACCOUNTING FOR ALL OF THE REVENUE OF THE COMPANY

Naturally, the duty of greatest importance, and first to be considered, is that of ascertaining that every penny of the revenue of the company is properly accounted for. Other contributors to this volume will show how this is done with regard to receipts and disbursements. The duty of the Chief Accounting Officer is to place those departments in the hands of men who are thoroughly competent, honest, and loyal.

Under the head of receipts are classified all earnings of the company from transportation of freight, passengers, etc. A system of reports, remittances, etc., must be put into effect which, when audited, will readily show whether all of the revenue that should be collected by agents, .conductors, and others has been actually collected and remitted to the treasurer of the company. The Chief Accounting Officer should give his careful and earnest attention to the details of the methods employed for that purpose, and should give his approval of the entire scheme. After such approval has been given, no change should be made by the subordinate accounting officer in charge of receipts, either in instructions, form of reports, methods, or otherwise, without the approval of the Chief Accounting Officer. It is proper for the subordinate officer in charge of receipts to conduct the business of his department without taking up the time of the Chief Accounting Officer, so long as no deviations are made in methods, forms, or instructions; but he should never make any such devia-

tions without the approval of his superior. Under this system the Chief Accounting Officer keeps in touch with the methods and plans for doing the work, but is not unnecessarily annoyed with details.

All the subordinate accounting officers should make a regular (preferably a weekly) report, in the form of a letter, or in such other form as may be prescribed, to the Chief Accounting Officer, giving the condition of the work, so that the latter may at all times have his fingers on the pulse of the various branches of his department.

What has just been said in regard to receipts is also true with reference to disbursements. A complete and thorough plan for auditing all money paid out by the company should be provided and approved by the Chief Accounting Officer, under which the Auditor of Disbursements will work, making no changes whatever in the blanks, instructions, or methods without the approval of his chief.

Leaving these two branches relating to receipts and disbursements, it will be proper to proceed to an outline of the general accounts, which usually are, and always ought to be, handled by the Chief Accounting Officer himself.

What is known as the "general ledger" should be kept by the Chief Accounting Officer as the one book in which all of the transactions of the company are finally recorded. For convenience, and to facilitate the work, various sub-ledgers are kept, in which the details of certain accounts are recorded, and from which the

net result of the transactions for each month is transferred to the general ledger. In all railroad accounting, the books are closed as soon as possible after the end of each month. General balance sheets, exhibiting the financial status of the company at the close of the month, and statements showing the income account for the last month, and for the fiscal year to the close of the last month, are rendered, and copies are furnished to the persons designated by the president as entitled to receive them. Obviously the transactions of a large railroad company are so numerous that it would be physically impossible for any one man to transcribe them all on one general ledger, and the use of sub-ledgers, or auxiliary ledgers, enables a large number of men to work on the accounts for one month at the same time.

It must be understood that the primary object of this general ledger, and of all the sub-ledgers, is to provide a method for ascertaining that the revenue of the company is all properly accounted for. For example, the station agents must be debited, through proper reports and records, with all the revenue that should be collected by them, and they must be credited with all of the money which they remit to the Treasurer; the balance represents money which for some reason has not been collected, and which subsequently must be accounted for. If an agent has been debited with an erroneous item, he must make proper application for credit—or "relief," as it is termed in railroad parlance; and if his application is found to have merit, the erroneous debit will be withdrawn; and so on. This

process must be accurate, to the detail of every way-bill, every ticket, every car switched, every item of excess baggage, storage, etc., collected; so that at any time the complete details of the items due from any individual agent may be stated on short notice. Likewise, conductors are debited with what they collect, and are credited with what they remit to the treasurer.

Other companies, firms, individuals, etc., are similarly debited with what is due from them, and credited with what is due to them. They are also debited with the cash paid to them, and credited with the cash received from them; so that the status of the account at the end of the month shows the balance due to or from each railroad company, firm, individual, etc.; or from them all as a whole. This process is followed all the way through, the object being to place a debit against some agent, company, firm, or individual for every penny due the railway company, and to place a credit for every penny received by the company, and every penny due to such companies, firms, individuals, etc. In this way the net result at the end of each month will show the balance due to or from each company, firm, or individual, or to or from all of them as a whole.

Ordinarily, the sub-ledgers that are kept in detail, and the net result of the transactions for the month posted in the general ledger, are as follows:

Freight-accounts ledger, kept by the Freight Accounting Officer.

Passenger-accounts ledger, kept by the Passenger Accounting Officer.

Record of vouchers audited, kept by the Disbursements Accounting Officer.

Record of bills audited, kept by the Disbursements Accounting Officer.

Material ledger, kept by the Disbursements Accounting Officer.

Freight-traffic, passenger-traffic, and car-service ledgers, either three separate ledgers, or all in one—kept by the Chief Accounting Officer.

Miscellaneous accounts with other companies and individuals, covered by audited bills rendered—kept by the Chief Accounting Officer.

Station agents' ledger, kept by the Chief Accounting Officer.

In some cases many other sub-ledgers are kept, according to local conditions, the principal object being to keep the general ledger free from voluminous details.

A few words about each of the ledgers mentioned may be of interest.

General ledger.—The general ledger should be kept by a thoroughly experienced bookkeeper, who is absolutely trustworthy and loyal. No entries should be permitted to be made in the general ledger without the approval of the Chief Accounting Officer. The entries to be made in the general ledger should be from three sources only—audited vouchers payable, audited bills collectible, and journal vouchers.

In making entries in the general ledger, such expres sions as "sundries," "various," etc., should be avoided, but in the column provided for describing the nature of the entry a comprehensive description should always be written. This description should be sufficient to indicate clearly the nature of the debit or credit, without making it necessary to refer to the voucher, bill, or

journal voucher for such information. Formerly all journal vouchers were entered in a journal, and postings to the ledger were made from the journal. The journal is superfluous, because all postings may be made more accurately and economically direct from vouchers, bills, and journal vouchers.

Freight-accounts ledger.—This ledger is kept by the Freight Accounting Officer, and records all debits and credits to station agents and other railroad companies in connection with the freight traffic of the line, except cash payments and receipts. In other words, this ledger is to contain a record of every penny due to and from the railway company on account of freight traffic. From this ledger, or from transcripts furnished the Chief Accounting Officer monthly, debits and credits are made in the freight-traffic ledger and the station-accounts ledger. From the freight-accounts ledger are obtained the total earnings on freight traffic.

Passenger-accounts ledger.—This ledger is kept by the Passenger Accounting Officer, and in it are recorded all debits and credits to station agents, other railroad companies, etc., except cash payments and receipts on account of passenger business. This ledger should contain a record of every cent due to or from the railway company on account of passenger traffic. From the ledger, or from a transcript thereof, which is furnished the Chief Accounting Officer each month, debits and credits are made in the passenger-traffic ledger and the station agents' ledger. From the passenger-accounts ledger is obtained the total earnings on passenger traffic.

Record of vouchers audited.—This record is kept by the Disbursements Accounting Officer, and in it is recorded every voucher representing money to be paid by the company. This record shows the name of the payee, a description of the expenditure, and the account to be charged with the amount of the payment. At the close of each month a transcript of the footings of this record is furnished to the Chief Accounting Officer in the shape of a journal voucher, and such footings or totals are entered in the general ledger. All vouchers payable which contain debits or credits to general-ledger accounts (accounts the details of which are kept in the general ledger) should be referred to the Chief Accounting Officer for posting in the general ledger before the audit of the voucher is completed.

Record of bills audited.—This record is kept by the Disbursements Accounting Officer, and contains a record of every bill against other railroad companies, individuals, firms, etc., representing money to be collected by the company. The record shows the name of the party against whom the bill is rendered, the nature of the bill, and the account to be credited. All bills containing debits or credits to general-ledger accounts should be referred to the Chief Accounting Officer, to be posted in the general ledger before the audit of the bill is completed. As in the case of audited vouchers, a transcript of this record, in the shape of a journal voucher, is furnished the Chief Accounting Officer at the close of each month, to be posted in the general ledger.

Material ledger.—This ledger is kept by the Dis-

bursements Accounting Officer, and contains a record of all material received, used, sold, transferred from one shop to another or from one operating department to another, as well as the balance on hand at the close of the month. A transcript showing the net result of the various debits and credits in this ledger is furnished the Chief Accounting Officer each month, to be posted in the general ledger.

Freight-traffic, Passenger-traffic, and car-service ledgers.—In these ledgers, which are kept by the Chief Accounting Officer, are entered all debits and credits to other railroads and transportation companies on account of interline freight traffic, interline passenger traffic, interline car service, or per diem paid and received in exchange of cars among railroad companies.

Debits and credits to interline freight accounts of other railroads, except cash receipts and payments, are posted from data furnished by the Freight Accounting Officer.[2] Such debits or credits represent the net balance agreed upon with other companies before they are posted, and are subject to sight draft on the Treasurer of the debtor company.

Debits and credits to interline ticket accounts, except cash receipts and payments, are posted from data furnished by the Passenger Accounting Officer,[3] and represent the amount of interline ticket sales reported by and to other companies. The amounts of reports rendered by other companies are, of course, debits, and those rendered to other companies are credits to such

[2] See remarks regarding freight-accounts ledger.

[3] See remarks under passenger-accounts ledger.

companies. The balances arrived at by ascertaining the difference between the reports rendered to and by other companies are subject to settlement by sight draft on the Treasurer of the debtor company.

The debits and credits to car-service accounts, except cash receipts and payments, like those to ticket accounts, represent the amounts of reports rendered to and by other companies, and are based on journal vouchers prepared by the officer who has charge of the car-service accounts, or from journal vouchers supported by statements rendered by such officer. The balances arrived at by ascertaining the difference between the reports rendered to and by other companies are subject to settlement by draft on the Treasurer of the debtor company.

The agreed balances due to or from other railroad companies should be posted in the freight-traffic ledger daily as fast as agreed upon, and drafts should be made daily for such balances when they represent money due from other companies. The amounts of all reports rendered to other companies covering ticket sales, car service, or per diem should be entered when the reports are rendered. Reports received from other railroads should be posted daily as received, and all balances due other companies should be drawn for daily. If this rule is observed carefully, the revenue of the company is collected promptly and placed in the treasury, where it belongs, without delay.

All cash receipts and payments in settlement of freight, ticket, and car-service accounts represented by drafts and remittances are entered in detail in these

ledgers to the debit or credit of the various accounts. At the close of the month the net result of the debits and credits on these ledgers is transferred to the general ledger through a journal voucher, so that the general ledger will represent the net result of all transactions recorded on the sub-ledgers.

The freight, passenger, and car-service accounts are sometimes kept in one ledger and sometimes in separate ledgers, according to the volume of business.

Miscellaneous accounts with other companies and individuals, covered by audited bills rendered.—A separate ledger, or a series of ledgers, is kept by the Chief Accounting Officer, in which are entered all charges to other companies and individuals, through audited bills rendered, using a separate page for each company, except in the case of certain individuals against whom bills are rarely rendered, which are grouped together in alphabetical order, under the heading "miscellaneous." This ledger should show the number of the bill, its nature, the amount, the date on which rendered or sent out for collection, and to whom it is sent. The cash received in settlement of bills should be posted in detail in this ledger, so that at any time a detailed list of unsettled bills against any company or individual may be drawn off at a moment's notice.

This ledger should be examined very frequently by a competent clerk, and statements requesting settlement should be sent to all companies and individuals when bills become overdue.

With railroads where the number of bills rendered is large, the following division of three ledgers is

recommended: (*a*) claims ledger; (*b*) transportation companies—miscellaneous bills; (*c*) other companies and individuals—miscellaneous bills. Such a division facilitates, by segregation, the balancing of accounts at the close of the month, and has the advantage of keeping in a separate ledger bills rendered against individuals, and companies other than transportation companies, the status of which should be watched very closely, because such bills should usually be paid within a few days after they are rendered. The miscellaneous bills against transportation companies are not paid so promptly as those against individuals, on account of the routine through which they pass before they are ready for payment. The settlement of bills on account of claims is usually a little slower than that of miscellaneous bills; hence the above separation is recommended.

At the close of the month the net result of the various debits and credits entered in this ledger is transferred to the general ledger by journal voucher, so that the general ledger will contain a record of the net result of the transactions recorded in detail in this ledger.

Station agents' ledger.—In this ledger are recorded all debits and credits to station agents from data furnished by the Freight Accounting Officer and Passenger Accounting Officer,[4] as well as all the cash remittances received from station agents. At the close of the month the net result of all the debits and credits

[4] See remarks under freight-accounts ledger and passenger-accounts ledger.

on this ledger is transferred to the general ledger by journal voucher, in order that the general ledger may contain a record of the result of all transactions entered in detail on this ledger.

It is important that the station agents' ledger be watched very closely, to see that agents remit the amounts collected by them promptly and in accordance with the instructions. A sufficient force of Traveling Auditors should be employed to examine the accounts of all agents at least twice each year, in order to ascertain if their accounts are being kept according to instructions; if they are correct and do not contain any items that would not be disclosed by the monthly reports to the Accounting Department; and if the cash on hand on the date of the examination is sufficient to cover the balance due the railway company on that date.

In addition to the foregoing ledgers, which as a rule are kept by the Chief Accounting Officer of all railroads, others are frequently employed; but the same principle governs all, viz.: the details of the various transactions will be recorded in the sub-ledgers, and the results of such transactions will be transferred to the general ledger by journal voucher each month. The fact that the final result of every transaction of the railroad company should be recorded in the general ledger should never be lost sight of.

Besides the Traveling Auditors, Traveling Accountants should be employed to examine at short intervals the accounts of the various division officers, in order to ascertain if they are being handled accurately

and intelligently. Occasional examinations should also be made of the accounts of express companies, union depot companies, and all other companies in which the railroad whose books are under consideration has an interest. Such examinations should be made from the original entries and books of the companies, to the end that the Chief Accounting Officer may at all times know that every dollar of the revenue, whether due from an agent, conductor, railroad company, express company, union depot company, etc., is properly accounted for. This inspection of the accounts of other companies is not for the purpose of examining their interline freight, ticket, and car-service accounts, because the company whose books are under consideration should have at all times in its own files data with which to verify the accounts of such companies.

The foregoing, in a general way, outlines the duties of the Chief Accounting Officer under the head of "proper safeguarding and accounting for all of the revenue of the company." Of course, an entire paper could be written on any one of these items, but space will not permit of further mention here.

II. PRESENTING TO THE PRESIDENT AND OTHER OFFICERS A TRUE HISTORY OF WHAT HAS BEEN ACCOMPLISHED, MORE OR LESS IN DETAIL, ACCORDING TO CONDITIONS

Under this heading it is necessary to classify the accounts of the company without regard to any direct payment or receipt of revenue. The two principal statements used for furnishing a history of what has

been accomplished are the balance-sheet and the income account. At the outset it should be borne in mind that the figures used in the balance-sheet and income account must be those recorded in the general ledger. No item should ever be entered in either of these reports which is not recorded in the general ledger; therefore it is necessary, in preparing the headings for the accounts in the general ledger, to have due regard for the requirements of the balance-sheet and income account, as well as to provide for determining that all of the revenue of the company is properly accounted for.

Balance-sheet.—The balance-sheet, which is frequently called the "general balance-sheet," contains a complete statement of all the accounts on the general ledger, including those shown in the income account. This report requires a classification of accounts into "assets" and "liabilities." The asset accounts are shown on the debit, or left-hand, side of the balance-sheet, and the liability accounts on the credit, or right-hand, side.

The asset accounts are further divided into "property accounts" and "operating current accounts." The property accounts represent the cost of the plant or railroad property operated, being usually divided into (*a*) cost of railroad franchises, and (*b*) equipment. In the early days of railroad bookkeeping equipment was not always kept separately, and even today some companies have not introduced this feature. Such separate account is, however, very desirable.

The operating current assets represent the accounts which are being realized upon from day to day and

from month to month, such as: cash on hand; balance due from station agents and conductors; balance due from other railroads, transportation companies, and individuals; balance due from express companies; balance due from the United States government as compensation for carrying mail; material and supplies on hand; etc. They are the accounts which, if the operation of the property were discontinued and the railroad abandoned, would all be disposed of by cash settlements, barring a few which might not be collectible.

The liabilities are classified into "capital or property liabilities" and "current or operating liabilities." The capital or property liabilities usually represent the amount of capital stock and funded debt outstanding against the property. The current or operating liabilities represent amounts due to other railroads, transportation companies, and individuals, to various states for taxes accrued but not paid, unpaid wages not called for, etc. Like the current or operating assets, they are those which, if the operation of the property were discontinued, would be closed out by cash settlements.

In the balance-sheet is also included, on the debit or credit side as the case may be, the balance of the income account. If there is a surplus, the total assets will exceed the total liabilities, in which case the balance of the income account is entered on the credit side of the balance-sheet and forms a perfect balance for the two sides. In case of a deficit, the balance of liabilities will exceed the assets, and the balance of income account will be entered on the debit side of the balance-sheet, thus also forming a perfect balance.

The total debits on the balance-sheet should always equal the total credits to a cent.

With regard to classifying expenditure, accountants of the present day appreciate more fully than their predecessors the importance of charging to the property account all actual additions to the plant in the shape of additional track, structures, rolling-stock, etc.; also of making proper charges to the property account when an existing structure or a portion of the property is materially improved; as, for example, when a pile bridge is replaced by a steel structure, or when a wooden depot which cost $2,000 is replaced by a stone structure costing $15,000. The original structures in such cases are more or less temporary, and, when they are replaced with more expensive and practically permanent structures, an appropriate increase should be made in the property account, and operating expenses under the head of maintenance should be charged with approximately what it would cost to renew the old temporary structure throughout in kind. In past years, when accounting for the expenditures of railroads, this important feature did not receive the attention given it today. It is doubtless a fact that many substantial improvements were charged to operating expenses because of the failure to draw the line properly between expenditures for additions to the property and expenditures for the maintenance of existing property. It is also doubtless true that many new sidetracks, and entirely new and additional buildings, have been charged to operating expenses of the different companies throughout the United States. Subsequently some of these ex-

penditures were capitalized, as was proper, which gave color to the accusation that the stock was watered. Even though the directors may voluntarily decide to pay for certain improvements out of the net income of the company, after taxes and fixed charges have been provided for, yet it is desirable and necessary to keep the expenditures separate, so that the total actual cost of the property is always known.

The foregoing is simply an outline of the balance-sheet, which should be rendered in sufficient detail, according to requirements and local conditions, to exhibit the status of all accounts on the ledger. A comparison should also be arranged, so that the increases or fluctuations of the different accounts may be seen from an examination of the balance-sheet.

This report is the foundation of the whole structure of the accounts of a railroad. It is deserving of very careful attention by the Chief Accounting Officer, and careful perusal by the executive officer.

Income account.—The statement of income account shows the total gross earnings, of the railway company, usually classified as freight earnings, passenger earnings, mail earnings, express earnings, telegraph earnings, and miscellaneous earnings. From the total of these classes of gross earnings are deducted the total operating expenses, usually classified as follows: maintenance of way and structures, maintenance of equipment, conducting transportation, general expenses.

The amount left, after deducting the total operating expenses from the total gross earnings, represents what is termed in railroad parlance the "net earnings"

of the company. To these net earnings are added income from interest on bank balances, interest on miscellaneous obligations due the company, dividends on stocks owned, interest on bonds owned, rents of property not used in the operation of the road, etc. The sum of the net earnings and this miscellaneous income represents the total income of the property. From that amount are deducted the amount paid for taxes, the fixed charges representing interest on bonds, or mortgage debt outstanding, rental of property leased from other companies, etc. After the total amount paid for taxes and fixed charges has been deducted from the total income, the balance left is applicable to dividends, or may be used in the improvement of the property, or in such other way as the directors of the company may see fit.

The foregoing brief statement of the income account is supported by other statements, more or less in detail for the purpose of making intelligent comparison with the previous results from operation, in order that any increases or decreases may be discovered, and their cause located. Such detailed statements prevail more largely with regard to operating expenses than with any other of the classes of items mentioned.

Sometimes the freight earnings are segregated into a few classes, which is true also of passenger earnings; but great detail is observed with regard to operating expenses. The Interstate Commerce Commission some years ago issued a classification of operating expenses required in the compilation of reports of railroads to that body, and that classification has been largely

adopted by railroads throughout the country. Some railroad companies compile further details than are required by the commission, but it is usually done by subdividing the different accounts of the commission classification.

Any discussion of the detailed classification of operating expenses belongs more properly to the paper on disbursements accounts; hence this will not be further dealt with here. Suffice it to say that all the items mentioned in the foregoing statement of income account should be supported by sufficient details to make it possible to locate and explain any appreciable increase or decrease in any of the items comprising the account.

The theory of the arrangement of the items of the income account, stated herein, is as follows: The owners of the railway property turn it over to an operating executive, who has charge of all its operations, and who is expected to secure satisfactory operating results. In order to show the results of his operation of the property, the operating executive should include, under the heads of the various classes of gross earnings and operating expenses, every cent of receipts or expenditure in direct connection with the operation of the road, and, on the other hand, should not be permitted so to include any receipts or expenditures not connected with the direct operation. If this plan is followed carefully, the item of net earnings will correctly represent the net return which the operating official presents as the result of the operation of the property. To that item may be added receipts from sources not directly connected with the operation of the property; and from

this total income will be paid the taxes on the property, the interest on the funded debt covering the property, and other items known as fixed charges; leaving the balance, or net income, to be disposed of by the directors. It is believed that this arrangement is logical, and also that it has the advantage of fixing the responsibility of the operating official. If the item of net earnings should be arrived at by including any receipts or expenditures not connected with the operation of the property, the term would have little meaning.

In addition to the statement of income account, all of the principal items of increase and decrease in the details thereof should be investigated, and a written explanation of such increases and decreases should be furnished the President or other executive official monthly by the Chief Accounting Officer.

The form of income account used by some railroads may be much more elaborate than here outlined, according to the requirements and local conditions, but it is believed that the foregoing is a good foundation upon which to build more elaborate structures.

With regard to balance-sheet and income-account statement, it is recommended that the balance-sheet show the total debit or credit balance in each account, as of date the balance-sheet is rendered, the increase or decrease during the current month, and the increase or decrease during the current fiscal year. It is also recommended that the income-account statement show the results for the current month and for the current fiscal year to date, compared with the same month of

the preceding year and the corresponding period of the preceding fiscal year.

In order to make proper comparisons of the monthly income account, estimated charges should be made monthly to taxes, interest on funded debt, and all other items, entering into the composition of the income account, which are not paid monthly. Such monthly estimate should represent, according to the best information obtainable, the amount that would accrue for that month if the settlements were actually made monthly. As such estimated charges are made to taxes, interest on funded debt, etc., they should be credited to the proper accommodation accounts to which the payments should be charged when actually made. Likewise, in compiling operating expenses for a month, when large items accrue which are chargeable or creditable to operating expenses, but which have not been taken into the accounts through the regular channels, due to some delay in settlement, then estimates should be charged or credited to operating expenses, and taken into an accommodation account, so that the statements which are rendered will represent as nearly as possible, from the best information obtainable, the operating expenses of the month, whether the cash has actually been paid or not.

The purpose of the operating-expense statements is not to record the receipts and expenditures on account of operating expenses, but to record the cost of operating the property during a definite period. They are history, and as such should be accurate.

For example, suppose that A uses, under a long-time lease, sixty miles of track belonging to B, and pays therefor large sums for rental and for its proportion of the operating expenses. Suppose, further, that, through the failure of B to render bill for the month of January, or through the failure of A to record a proper voucher in favor of B covering payment for the use of the line, A's operating expenses for January have not been charged in the regular way with its portion of the operating expenses of that part of the line. Certainly the operating expenses of A should not be relieved of all charges on account of that sixty miles of road during the month of January. A has used the road, has incurred the expense, and owes the liability for such expense. Therefore, by debting the operating expenses with the estimated amounts due B, and crediting B through the accommodation account, the operating expenses are more accurately stated, as also are the liabilities of the company, than if the account had been omitted entirely. In fact, omission of the account would make the history wrong. Hence it is a common practice among railroads to make monthly estimates of items of expenditure which accrue, but which are either not due or not in shape for payment at the time the accounts for the month must be closed.

Of course, other statements are presented to the President and to other officials, which contain a history of the operation of the property, showing train mileage, car mileage, tons one mile, passengers one mile, earnings per train, earnings per car, etc., etc. These may be multiplied according to requirements or local condi-

tions, but the balance-sheet and income account are never omitted; they are standard.

III. TO CALL THE ATTENTION OF THE PRESIDENT OR OTHER OFFICERS TO ANY FAVORABLE OR UNFAVORABLE CONDITIONS OR CIRCUMSTANCES WHICH MAY COME TO THE KNOWLEDGE OF THE CHIEF ACCOUNTING OFFICER

It is difficult to explain in detail just what should be done under this heading; so much depends upon circumstances. The Chief Accounting Officer, however, in his daily contact with the accounts of the company, will, through statements and comparisons, develop matters of interest—sometimes favorable, sometimes unfavorable—which should be promptly brought to the attention of the proper officer, when it is not within the jurisdiction or power of the Chief Accounting Officer finally to dispose of the matter. To this end, as well as with the object of promoting accuracy, it is recommended that the various results be tabulated in books provided for the purpose, in such a manner that the results from each item for the current month will be entered directly under or alongside of the results for the previous month, and the result for the corresponding month in the preceding year, together with the continuous results throughout the year. By having the information stated in this way, any unusual increases or decreases will be readily apparent, and should be investigated. If the investigation develops any conditions which cannot be finally dealt with by the Chief Accounting Officer, it should be reported to the President or

proper official of the company, for necessary attention.

The Accounting Officer should not confine himself to simply accounting propositions, but should be broad-minded and endeavor to take in all the conditions of the operation of the property. Sometimes the results recorded in his office will show that the equipment owned by the railway company is slipping away to other lines too rapidly; or the records may show that the company is holding its own remarkably well in keeping the equipment on the line. Both favorable and unfavorable conditions should be noted and reported. The practice is too common of reporting all unfavorable conditions, and to preserve silence with regard to favorable conditions—a practice easy to acquire and difficult to abandon. The records may show that a certain class of material—as, for example, coal—is costing too much; or that it is being purchased very economically; in either case the fact should be reported promptly. In fact, the Accounting Officer should have his eyes and ears open all the time, to detect matters of interest to his superior officers, and should not hesitate to report such matters without fear or favor.

This paper would be exceedingly deficient if the all-important subject of providing proper help should be omitted. The Chief Accounting Officer personally can do practically none of the work outlined herein. He must depend upon others to perform the work for him. Therefore, this peculiarly important phase is left to be dealt with in a few closing words.

Most people will recognize at once that for his lieutenants in charge of the different departments the Chief

Accounting Officer must have men of undoubted loyalty, ability, integrity, and possessed of character which commands the respect of all. And it may be added that precisely the same qualities should be required of the office boy who starts at the bottom. The best results will be obtained by following civil-service rules; filling all vacancies by promotions whenever it is possible to do so. This encourages all to look forward to promotion when earned and when the opportunity arises. If the same care is used in hiring the office boy as in hiring the Auditor, employees worthy of promotion will be found in all intermediate positions. To do this successfully requires a practical knowledge of human nature as well as of accounting methods.

THE AUDITOR OF EXPENDITURES

HARRY M. SLOAN, AUDITOR OF DISBURSEMENTS, CHICAGO, ROCK ISLAND & PACIFIC RAILWAY

Before looking into the methods to be pursued in accounting for the expenditures of a railway property, it may be well to arrive at a thorough understanding of just what the word "expenditures" means. While my subject has been outlined as dealing with the "Auditor of Expenditures," the term selected is not now so generally used in railway parlance as is the term "Auditor of Disbursements." Webster's *Unabridged Dictionary* defines the first term—viz., "expenditures" —as follows: "the act of expending; a laying-out, as of money; disbursements;" and the verb "expend" is defined: "to lay out, apply, or employ in any way; to consume by use; to use up or distribute, either in payments or in donations; to employ; to dissipate; to waste." The term "disburse" is defined: "to pay out or expend;" and "disbursement," as "the act of disbursing or paying out." From this it will be seen that it is largely a matter of personal taste whether the term "disbursement" or "expenditure" is used.

Some people are unkind and unthoughtful enough to apply to us the appellation "auditor of disturbances;" and, if the truth must be told, some railway employees and officials are so averse to having an account audited that bears their approval that the auditor must at times take such drastic steps to secure enough informa-

tion to enable him to pass the paper for payment that he becomes a disturbing element, at least to the employee under investigation; hence the title "auditor of disturbances." In my limited experience as an auditor I have also been addressed, by one of the coal-wharf foremen on the line of our road, in a Western Union message regarding the whereabouts of certain moneys due him as "editor of distribution." But, as it has been said of the rose that it would, under any other name, smell just as sweet, so it is probably true that the Auditor of Expenditures, under any other title, would perform his duties just as satisfactorily or unsatisfactorily.

Railway accounting resolves itself, in the end, into two distinct heads, viz., receipts and disbursements.

"Receipts" must not be confounded with "revenue," inasmuch as the former is a much broader term than the latter; in fact, in the operation and financing of some of our great railway systems the revenue is quite small in comparison with the receipts. The term "receipts" would include amounts received by the company for bonds and stock issued and sold, but such receipts would in no wise be a revenue; again, it would include the total freight charges collected on a shipment originating on one line and routed via another line, while only a very small part of such collection might be revenue, or earnings.

Most railways of any considerable size have an organization which provides for two Auditors of Receipts—viz., an Auditor of Freight Receipts and an Auditor of Passenger Receipts—and one Auditor of

Disbursements. The three offices are conducted as distinct organizations, so far as practicable. There are, however, a number of cases where the work of the different offices overlaps to a great extent. For instance, in the case of auditing the expenditures on account of loss and damage, and overcharge claims, there is a decided advantage in having such Loss and Damage and Overcharge Department either a part of, or very closely connected with, the office of the Auditor of Freight Receipts, owing to the fact that scarcely an "overcharge" or "loss and damage to freight" claim is settled that does not have to be checked more or less against the records in the office of the Auditor of Freight Receipts—that is, against the abstracts of the billing, or the original or copies of the bills themselves.

On the other hand, there are certain receipts that can more economically be accounted for in the office of the Auditor of Disbursements; namely, those which affect the operating expenses of the road; or, as a matter of fact, any receipts not in the nature of revenue, other than those of a strictly financial character, which are usually taken care of by the Chief Accounting Officer. The accounting for such receipts is, in fact, simply a part of the work of auditing the disbursements. For instance, if one railway company operates a terminal which is used jointly by several other companies, the work of auditing the disbursements of that particular portion of the line is not complete until proper bills have been rendered against the tenant lines for their proportion of such expenditures.

It might be mentioned here, in passing, that the

question as to who is to see to it that such joint bills are promptly paid after they are audited is one upon which many roads differ. Some lines make this a part of the duty of the Auditor of Disbursements, while others consider it the duty of the General Auditor's or Comptroller's office, the latter class holding that the duty of the Auditor of Disbursements has been performed when he audits the bill. This is not, however, a question of vital importance, the main point being to insure that such collections are closely followed up by whomsoever the General Auditor or Comptroller designates for that duty.

Another phase of auditing on which a great many roads differ is the question of auditing construction expenditures. The settlement of this problem would seem to hinge on the question of how closely the executive management of a company desires such things looked after, and on the policy of the company in financing such expenditures. In the opinion of the writer, if it is the policy of the company to issue bonds for all construction expenditures, including additions and improvements, such expenditures should be audited in the office of the highest accounting official, so that he may at all times be entirely conversant with just what items are being charged against capital account, and convince himself that no such charges, however small, are made against this account without his personal approval. This opinion is supported by the fact that the executive officer, when seeking information as to accounts, invariably calls upon the highest accounting official for it, and keeps in close touch with the prog-

ress of all construction work. Hence, as a matter of personal pride and of protection as well, the General Accounting Officer should have the details of the construction expenditures on the tip of his tongue; and, to have them there, he must have the details under his immediate surveillance.

Expenditures or disbursements are made in a number of ways, but in the accounting all resolve themselves in the end into either "material" or "labor."

"Material disbursements," as known in accounts, must not be understood to mean actual material and supplies; for such is not the case. All payments other than those made on the pay-roll are usually treated as "material;" while, as a matter of fact, if such payments were traced back to the inception of the expense, they might be found to contain as high as 90 per cent. of labor charges. For instance, take contract payments, which are nearly always made by voucher and distributed to the proper accounts through the material distribution; probably 90 per cent. of most of these payments are for labor.

In accounting for "material" disbursements we have to deal with vouchers, drafts, bills, material distribution, and other mediums. Such claims as do not demand immediate settlement are paid by voucher; e. g., payments for material, contract labor, amounts due other companies for proportion of cost of operating joint facilities, etc., etc.

A voucher is a paper or document which serves to vouch the truth of accounts, or confirm or establish facts. In railway parlance, it is the document on which

the various officials certify that certain material has been received or certain labor performed; it is the evidence to the Accounting Department that the expense is a proper one for the company to assume, and the medium through which the expense is settled. Vouchers usually show the name of the company paying them at the top; this being immediately followed by—

To

____Dr.

This is followed by a brief statement of the facts, outlining what is being paid for, and the amount; all of which is then certified to by the officials whose certification is necessary before the payment can be made. On the bottom of the form is provided space for the receipt of the payee.

Such claims as demand immediate attention are paid by draft, drawn on the Treasurer of the company, by its duly accredited representatives. This class of claims includes many personal-injury claims, claims for loss by fire, and settlement for loss and damage of freight. A draft is an order for the payment of money, and usually reads somewhat as follows:

Pay to (John Smith) or order ($500.00) on demand

To (Quincy Adams), Treasurer.

Payments by draft should, so far as possible, be discountenanced, inasmuch as it is, under usual conditions, impossible to audit the claim before the payment is made. If the payment be made to an irresponsible party, the company is the only loser, unless the erroneous payment is of such a nature that it can be collected

from the company employee responsible for it; that is, in case the neglect or oversight of the representative is so palpable that it cannot be overlooked.

Another class of settlements is made by drafts of foreign lines on the Treasurer of the home company. The majority of these drafts, however, represent settlement of freight or ticket balances, and consequently their correctness is verified by returns from the office of the Auditor of Freight of Passenger Receipts, as the case may be.

As already stated, the auditing of an expenditure is not complete until all amounts due from others in connection with such expenditure have been collected. Such collections are made through the medium of bills. A bill is "an account of goods sold or delivered, services rendered, or work done, with the price or value annexed to each article." The auditing of bills will be described later.

Still other disbursements are accounted for through the medium of the "material distribution," these disbursements covering the use of material after it has been purchased and charged to stock, and, under the plan in vogue on most railroads (if the writer is correctly informed), including the distribution of the vouchers and bills to the expense accounts. This class of disbursements will also be more fully treated hereafter.

Let us now turn to the accounting in detail of disbursements made by voucher, after which we shall treat settlements by drafts, and the auditing of bills and material distributions, in order.

Under the method in vogue on some railroads, every expenditure, of whatever nature, must be covered by an approved voucher; under the method in vogue on others, the payments by drafts are taken care of through the cash-book without a voucher; but, under either method, the payments by voucher for a road of more than 5,000 miles will run from $50,000,000 to $100,000,000 per annum, such payments being, in all cases, heavier than those through any other medium.

Vouchers are prepared, in the first instance, by the department having immediate supervision over the expenditure. In the case of vouchers for material, they are prepared by the Purchasing Agent; in the case of vouchers for contract labor, they are prepared by the Superintendent or Engineer in immediate charge of the work; and so on.

The vouchers of most roads are prepared by the maker in such a manner that the Treasurer may, after the voucher has been approved for payment, affix his official stamp and make a sight draft of it, good at any bank he may designate. Some roads do not prepare their vouchers in this manner, but instead, after the voucher has been approved for payment, draw a check or warrant in payment, the only approvals on such check or warrant being those affixed in the Accounting Department. Each plan has its merits and its demerits; but, taken all in all, the former commends itself to the writer as being the more economical and practicable. Under the former method, vouchers are prepared by the maker in triplicate, the original to be sent out by the Treasurer for payment, the duplicate to be retained

by the maker, and the triplicate, with all supporting papers attached, to be filed in the office of the Auditor of Disbursements.

When a voucher has been certified by the maker, it is passed to his immediate superior for certification and approval; thence to the next superior officer, and so on, until it bears the approval of the head of the department originating it, after which it is sent to the Auditor of Disbursements to be audited.

The method of auditing a voucher varies greatly on different roads. Some roads rely on the check given the voucher in the outside, or division, office through which it passes before it reaches the Auditor of Disbursements; while others take nothing for granted. An Auditor of Disbursements of a road in the latter class is from Missouri—"he has to be showed."

All vouchers, of whatever nature, when they reach the office of the Auditor of Disbursements, are given a number and entered on what is known as the "voucher abstract." This abstract shows number, payee, what the voucher is for, amount, and distribution to the various accounts to which vouchers are charged. Here again roads differ greatly as to the method to be pursued. Some roads charge the voucher on the abstract to the person making it, or, in case of purchase vouchers, to the person to whom the material is shipped, and look to him to furnish a distribution of it to the different accounts—i. e., charging the different operating or construction accounts, and crediting himself; while other roads make the charges direct to the various accounts in the general office. The former method,

carefully and systematically carried out, commends itself to the writer.

Material purchases are covered by regularly approved requisitions; that is to say, the Purchasing Agent can purchase nothing unless he has the approval of the head of the department ordering the material. This approved requisition is forwarded to the office of the Auditor of Disbursements, where it is conveniently filed, and any and all vouchers received from the Purchasing Agent's office are checked against such approved requisitions before being paid, notation being made on the requisition to the effect that the voucher in payment of the same has been passed, showing thereon the number of such voucher. In the case of a purchase voucher, the only approval required is that of the Purchasing Agent, who certifies that the material has been purchased at the best price obtainable. It is obviously unnecessary for the purchase vouchers to be certified by the head of the department ordering the material, inasmuch as his certification and approval appear on the original requisition for the material, which, as stated above, is on file in the office of the Auditor of Disbursements, and against which the voucher itself is checked before it is passed for payment.

It will be apparent that it is impossible to pass a duplicate payment for material on any requisition, inasmuch as, when the second voucher is checked against the original requisition, it will be noted that the former voucher has been passed, and the second or duplicate voucher will consequently be canceled and returned to the maker.

In the case of recurring payments (or receipts)—that is, payments that have to be made regularly once each month, each quarter, or each year, as the case may be—the matter is usually covered by contract or agreement, and the Auditor of Disbursements is furnished with a copy of each and every one of these contracts or agreements, in so far as they pertain to his department. These are filed in some suitable way, so that they may be readily located; and when a voucher covering a payment provided for by contract reaches the Auditor, it is checked against the contract to the last detail, in order to see that the provisions of the contract are being fulfilled.

These recurring payments are also checked against a record of recurring payments when they reach the Auditor's office. This record is usually kept in a loose-leaf ledger, and a separate sheet is provided for each contract or each recurring payment. The sheet shows on its face the parties between whom the agreement is made, the date when made, and the date of expiration, and carries, in addition, an abstract of the agreement. It shows by whom the voucher should be prepared, and the date on which it should be made. On the bottom of the form, space is provided for the record for that particular payment monthly for five years, each month's record showing the number of the voucher and the amount. This record is examined once a month to see that every regularly recurring payment has been audited.

After purchase vouchers have been checked against the requisitions, and vouchers covered by contracts

have been checked against the contracts, they are given to the distribution clerk, who checks every addition, extension, and, so far as possible, price, on the voucher. The distribution men—or checkers, as they might be called—are supposed to see that every item included on any voucher is in the interest of the company; and if the vouchers do not show sufficient information on their face, or in the papers attached to them, to satisfy the checkers that the payment is being made in the interest of the company, they are returned to the makers for further and necessary information. This information should be so full and complete that it will be a permanent record of just why the payment was made.

All vouchers in payment for material or fuel shipped from off the line of the road must be accompanied by expense bills, showing either that there has been no freight paid, or how much has been paid. If the purchase contract calls for material free on board—in railway parlance, "f. o. b."—the line of road, there should be an expense bill to accompany the voucher in payment for such material. This expense bill will show either that the charges were paid by the consignor, or that they were advanced by the agent of the purchasing company at the junction point. If the expense bill shows the latter, it is the duty of the distribution clerk to see that the amount of freight charges so advanced is deducted from the invoice of the shipper and from the voucher in payment of such invoice.

If the material is bought f. o. b. point of shipment, and such point is located off the line of the road, an

expense bill is required in the same manner as in the former example, although the road is required to pay the freight. In case the road does pay the freight, which it does in a great many instances, the expense bill is referred to the Auditor of Freight Receipts, in order that he may certify that the rate paid is correct, and, if not correct, immediately take the matter up with the delivering line and obtain a refund of the overcharge.

The voucher, after having been thoroughly checked by the distribution men, is passed to the Index Clerk, whose duty it is to see that the payment is properly indexed. This is another branch of the work in the Disbursement Department that is handled very differently on the various lines. Some roads index only the name and number of the vouchers; others index the name, number, and amount; others, the name, number, amount, and description; while still others run a debit and credit ledger account with each and every person from whom they receive a bill for payment.

The use of the index is dual; that is, it serves as a guide for future reference, in case reference is ever made to the voucher in question, and it serves the more important purpose of providing a check against duplicate payments. The former use is, of course, the primary one, and the more general; in fact, it is the only use to which some roads put their index. The latter use, however, is not the less important.

The best method that suggests itself to the writer, taking into consideration the economy that each successfully conducted department of a railway company

must practice, is to index: (1) the number of the voucher; (2) the name or names; (3) the date of the bill; (4) the number of the bill; (5) a description, short and concise; and (6) the amount. This, provided but one bill is paid by each voucher. In case more than one bill is paid, the date, number, and amount of each should be indexed.

Indexing in this manner will, of course, permit the index clerk to detect any duplicate payments that may get up to him without having previously been detected. He is, however, as it were, the court of last resort, and if a duplicate payment is overlooked by him, the only protection the company has is the honesty of the man who receives the payment. Therefore, the index clerk should be one of the brightest, quickest, clearest-headed, and clearest-eyed clerks in the office. In fact, a perfect index clerk should have second sight. It is, however, most remarkable what a degree of second sight a first-class index clerk will develop. I have several times been astounded to see what the clerks will pick up on the index—not errors which they are expected to discover, but errors which one would not expect them to find at all, and which it is nearly impossible to explain how they did find, except to say that they had a "hunch." This is equally true of the distribution clerks mentioned previously. They become extremely valuable to the company, and every day's experience teaches them some new thing to look out for.

The influence exerted by a first-class Auditor of Disbursements office in the matter of accurate accounting

by the outside or line offices is considerable. Each duplicate payment and each error that is discovered make the perpetrator of the duplication or error just so much more careful in the future; provided always, of course, that he has the interest of the company at heart; and those employees who do not have the interest of the company at heart should be weeded out as soon as discovered. As a few weeds will soon destroy a fine lawn, or one rotten apple in a barrel spoil all the good ones, so will a few "don't-care-for-the-interest-of-the-company" clerks soon sow dissension and a don't-care spirit in an otherwise well conducted office.

When a voucher has been carefully audited in the office of the Auditor of Disbursements, it is passed along to the approving officer, who approves it for payment, which is the final action of the Accounting Department, so far as the voucher is concerned, until after it is paid by the Treasurer. When a voucher, which has been sent out for payment by the Treasurer, is returned by the bank, it is transmitted by the Treasury Department to the Auditor of Disbursements, who checks it off against the voucher abstract and marks the record "Paid," showing the date paid. It is then returned to the Treasurer for filing, it being his evidence that he has paid the amount shown thereon, and, consequently, is entitled to credit for that amount.

Let us now briefly consider the auditing of payments by draft. As stated before, only such settlements should be made by draft as demand immediate payment, such as personal-injury and live-stock claims, and some loss and damage claims, viz., those that can be settled more

advantageously by immediate payment. When such drafts are paid by the Treasurer (and they should never be paid by him until they have been referred to the Accounting Department for approval), they are charged to some appropriate suspense account, and later cleared therefrom either by a "credit in account" voucher or by journal entry. The reason for this is apparent when it is remembered that, in a great many instances, there is no information available in the general office, at the time the draft is paid, as to what account the payment is chargeable to. The details of the transaction are obtained later on, and as soon as obtained are used as a basis for an entry to clear the suspense account. It should not be understood, in this connection, that a separate entry is made to cover each such transaction. Often a blanket entry is made covering an entire month's settlements of this nature.

Another form of disbursement is the settlement of foreign-line drafts; but, as stated before, most of these cover interline passenger or freight balances, and are taken care of by the Auditors of Receipts. Consequently, they are only mentioned here.

In some instances, foreign lines make drafts for their proportion of the expenses of operating certain joint facilities; i. e., roads will often agree with each other, during the formulation of a contract, to make such settlements by drafts in order to facilitate payment. These are comparatively rare, however, and when such a practice is in vogue, such drafts are treated in the accounts of the paying company in

exactly the same manner as the Claim Agent's drafts, above referred to.

Another form of draft settlement is the settlement between railway companies of freight claims—that is, overcharge or loss and damage claims—by draft. This is quite generally practiced between most lines at the present time, and is a convenient and economical method of settling such claims. In this case the Freight Claim Department issues what are known as "freight-claim authorities" to connections in settlement of such claims. The freight-claim authorities are subject to draft, and, when issued, are credited on the books of the company to an account known as "freight-claim authorities issued" and charged to the appropriate expense accounts. When the draft of the creditor company is presented for payment it is paid and charged to the same account, thereby clearing it.

Let us now look into the method of handling bills. As was stated above, the auditing of a disbursement is not complete until all bills against other companies and individuals in connection with such disbursements have been made and rendered. When any labor is performed or material furnished for another company or individual, it should be charged forthwith to that company or individual, and should not enter into the expenses of the company doing the work in any way whatever. When the charge to the other company or individual has been made in the distribution book—which book will be more fully described later on—it should be cleared by rendering a bill against such individual or company

covering the service performed, with a fair addition thereto for superintendence, accounting, etc.

This bill is sent for approval through the same channel as the voucher, previously described, and when it reaches the office of the Auditor of Disbursements, it is as thoroughly checked as is the voucher, being checked against the contract, provided one has been made to cover. Here again the alertness and clear-headedness of the distribution men stand in good stead. They are supposed to see that the bill is made to cover every possible item that can legitimately be included therein—such as freight charges, percentage for supervision and accounting, etc.—and that all labor bills are figured on the proper basis. There is a false feeling, on the part of some officials and employees, that a bill is not of very much consequence, and that their best attention should be given to the preparation of vouchers. A bill is, however, just as important as a voucher. The only difference, if an error exists on each, is that in one case we are paying out too much money, while in the other case we are not including in the bill what has been already paid out for the account of the company against which the bill is being prepared. There is absolutely no difference so far as the ultimate effect on the finances of the company is concerned.

Bills are prepared and audited in very much the same manner as vouchers, receive just as much attention from the Accounting Department, and are considered just as important. As stated before, the method of handling the collection of bills after they are audited varies with the different roads. It is the sense

of the writer that all such collections should be handled by the Auditor of Disbursements, owing to the fact that the bills are audited in his office, and all of the records in connection with them are kept by him. A great many Chief Accounting Officers, however, prefer to have this done in their own office, in order that they may keep in closer touch with the collections.

In this connection we might consider the handling of foreign-line bills against the home company. The most economical and best method, from an accounting standpoint, is to have every foreign-line bill, of whatever nature, forwarded in the first instance to the Auditor of Disbursements of the home line, who will give it a number and take record of it in his "foreign-line bill record" which shows the following information for each bill: Auditor's number—that is, the number given to it by the road against which it is made; date received; foreign bill number—that is, the number given it by the road rendering it; description; amount; to whom forwarded for voucher; and the number of the voucher in payment of the same.

This record is quite indispensable. While it is, in a sense, an item of expense for which there is no return, it is in another sense an economical measure. Even when railroad companies do the best they can, there is apt to be some delay in vouchering foreign-line bills. Such foreign lines frequently become impatient at the delay and trace for settlement of their bills. If the foreign-bill record were not kept, the auditing office would have no record of the movement of the bill, and considerable correspondence would ensue, which, with

the foreign-line record in use, could be eliminated. Again, it is only fair to handle foreign-line bills promptly, even though they do not trace for payment. With this record in use, the Auditor's office can trace the officials of its own line for bills which have not been vouchered promptly, and thereby hasten settlement. Such settlements should be hastened for more reasons than one. One very good reason is that some railway companies have a practice of holding up payments due other lines until such other lines pay amounts due them. While, in some cases, this may appear to work a hardship, it is, in theory, only a hint to follow the Golden Rule: "Do unto others as you would have them do unto you;" although it must be admitted that it often works out as an application of the Golden Rule per David Harum, viz.: "Do unto others as they would do unto you, *but be sure and do it first.*"

The method of handling vouchers covering the purchase of material has been described, and it will be remembered that the method provides that the voucher shall be charged, in the office of the Auditor of Disbursements, to the official to whom the material is shipped. When it has been charged to him, it stands so charged until he credits his account by charging it to an appropriate operating, construction, or other account.

When material is shipped to an official of the company, he is responsible for it, and it is for him to see that he gets an approved order for all of such material as is disbursed or used. The approved orders, each showing to just what use the material is to be put, are assembled each month on some convenient form, on

which the charges to each account are segregated. At the end of the month these figures are recapitulated according to accounts, and forwarded to the office of the Auditor of Disbursements, where entries are made charging the different accounts in the books of the company and crediting the different officials with the amounts so charged. It will be seen, from an analysis of this method, that it is to the interest of each official to see that no material is used or disbursed for which he has not received approved orders, inasmuch as the material, when shipped to him, is charged to him, and the only way he can get credit for it is to charge it out to an appropriate account; and he can make no charges to the accounts except from an approved order.

At least once each year an inventory is taken of all available material and supplies on hand; this inventory being taken by actual count, weight, or measurement. When the inventory of material in charge of a certain official is taken, the total is compared with the amount charged to such official in the general books of the company. If his inventory falls short of the amount so charged to him, it is evidence that he has been lax in the discharge of his duties, and that he has allowed considerable material to be used (or stolen) for which he has never received an approved authority, and for which, consequently, he has never been credited in the books of the company. This leaves the official open to criticism and, in some cases, reprimand, in addition to making large adjustments necessary in the accounts of the company, inasmuch as any surplus or shortage revealed by the inventory has to be adjusted in order

to bring the book balance of the material account into accord with the actual material on hand as shown by the inventory.

Railway companies provide classifications for their employees to follow in making material and labor charges, both against "operating expenses" and against "construction accounts." These classifications differ according to the needs of the different roads, but, as a general proposition, all roads follow as closely as possible the classification provided by the Interstate Commerce Commission, which provides for the subdivision of "operating expenses" under the following four heads: "maintenance of way and structures," "maintenance of equipment," "conducting transportation," and "general expenses." It also provides for a further subdivision of these four headings—the first into ten accounts, the second into nine, the third into twenty-seven, and the last into seven,

Some railway companies, owing to the vast territory covered by them, feel the need of a further subdivision than is provided by the Interstate Commerce Commission classification, but such further division is usually made so that the accounts, when necessity demands (which it does at least once each year), may be consolidated under the commission classification. It is prescribed by law that each and every railway company doing interstate business shall render returns to the Interstate Commerce Commission, covering the operation of its property for the year ending June 30, these returns to be made on forms prescribed by the commision. It is largely owing to this fact that the dif-

ferent companies follow as closely as possible the commission's classification.

The Accounting Departments of the different railway companies are gradually coming more into accord on their classifications through the efforts and influence of the Association of American Railway Accounting Officers—an organization formed by the accounting officers of the various lines—which meets once a year to discuss ways and means of bettering present accounting methods. In this way the association obtains the best thought of all the accounting officers of America.

In the classification of the Interstate Commerce Commission are laid down definitions of every account, and rules and regulations governing the method of making charges to each. It is the duty of the employees of the road to make exhaustive study of the rules and regulations as laid down in the classification, as in no other way can the distribution among the different accounts be made with any degree of accuracy. While, of course, these distributions are checked by the Accounting Department, their correctness nevertheless depends in a great measure on the original distribution made by the timekeepers, shop clerks, etc., owing to the fact that there is a great deal of the detail that cannot be checked in the Accounting Department. There is only one way in which the timekeepers and distribution clerks, as well as the officials themselves, can become thoroughly conversant with the rules and regulations as laid down in the classification, and that is by making a study of them.

As previously stated, disbursements segregate themselves into "material" and "labor" disbursements. The different phases of accounting for "material" disbursements have at least been mentioned in passing. The "labor" disbursements cover only such expenditures as are paid through the medium of the pay-roll, and, consequently, but two items will be treated in this connection, viz., the "pay-roll" and the "labor distribution."

Claims for wages earned in the employ of the company are paid, through the medium of the pay-roll, by check—either pay-check, time-check, or unclaimed wage-check. These wage-checks, while being in reality a draft on the Treasurer of the company, are not in the same category as the drafts spoken of above, inasmuch as the expenditures covered by the wage-checks are audited before the payment is made, except in the case of time-checks, which will be more fully discussed a little later on.

We will now take up the question of auditing the pay-roll. But first it might be well, for the benefit of those who have never had experience in such matters, to describe a pay-roll. A pay-roll is a statement of amounts due employees for services performed, and usually shows: name; occupation; time worked; rate per hour, mile, day, etc.; amount earned; deductions (if any); and amount due. This information is all embodied in the pay-roll by the official preparing it. There is also space left to show the number of the check drawn to pay such wages, and, in some cases, for the signature of the employee and a witness. How-

ever, when rolls are paid by check, this, in the opinion of the writer, is unnecessary.

The pay-roll is certified to very much in the same manner as a voucher. Pay-rolls are made up from time-rolls, or time-books, and these time-rolls or time-books are usually made up from daily or other time-slips. The preparation of pay-rolls is something that cannot have too much attention. When an official makes and certifies to a pay-roll, he is practically drawing a check on the Treasurer of his company, and he should be just as careful in making the one as the other. There is no better motto for a young railroad man—or, as a matter of fact, any young man—than this: "Be as careful in handling the interests of your employer as you would be in handling your own." And when it comes to a question of paying out money, one should be even more careful, inasmuch as there are a great many ways in which a man may legitimately spend his own money, which, if applied to company funds, would be anything but legitimate.

The base of most pay-rolls is the time-slip or other report of work performed. This is filled out by the employee, and is a brief description of what he has done during the day, showing the time he commenced work, the time he quit, and what work he has been engaged upon during the period of time covered by the slip—this last in order that the timekeeper may make the proper distribution of his time. These time-slips are entered daily by the timekeeper in the time-book, and at the end of the month the time-book is footed, the total hours worked extended into money at the rate

of pay for the different classes of labor, and, after being proved, the time and wages are transferred to the pay-roll.

In many cases—such, for instance, as those of section men—the foreman of the gang keeps a time-book in which is entered the daily performance of each man. The average section man is entirely too ignorant to be asked to prepare time-slips, but the foreman, being at all times with his men, is virtually a timekeeper, and can keep an accurate record of each man's performance without any daily slips.

All of the employees in each department of each division are entered on one roll for convenience, and this roll is certified by the official in charge, and passed to his immediate superior for further approval and transmission. When it bears the approval of the highest officer in the department in which it originates, it is sent to the office of the Auditor of Disbursements to be audited. In the office of the Auditor of Disbursements, the pay-rolls are checked just as thoroughly as it is possible with the information at hand. All monthly rates are checked against the previous month's roll, and if any increases appear, they must be covered by a regularly approved authority. In the case of hourly rates, they are checked against the schedule covering such rates, and no deviation from the schedule is allowed without proper authority.

The correctness of the number of regular monthly men is also ascertained by check against the previous month's roll—this to prevent (in a measure) straw-men being carried on the pay-roll. All extensions,

footings, or calculations, of whatever nature, are thoroughly checked, after which record is taken of the total amount, which is credited to the unpaid wage account and charged to the official making the same. It is then forwarded to the highest accounting officer for approval for payment after which it goes to the Paymaster, in whose office the checks are usually drawn.

It used to be a somewhat general practice to pay employees in cash from pay-cars, but most lines have given up that dangerous and expensive method for the much safer and cheaper one of paying by check. As soon as the checks can be drawn by the Paymaster, they are sent out to the different division points for distribution to the employees.

There are a great many people—in fact, a great many employees—who think that the railway company pays two or three weeks after the end of the month in order to get the use of the money for that period. This is a fallacy that is born of ignorance, and is as far from the facts as anything could be. Railway companies pay at the time they do simply because it is impossible to pay any sooner. Anyone holding such an idea will probably quickly disabuse himself of it when it is learned that an average trunk-line railway of from 5,000 to 10,000 miles will draw from 25,000 to 50,000 pay-checks per month, and in doing so pay out from one to two or more millions of dollars. Anyone can see that payments aggregating such figures, and having to be made in such small amounts, cannot be made in one day, two days, or three days, but that it takes time to do it and do it rightly. Again, no one should deny

the railway company the privilege of making a thorough check of its pay-rolls before paying them. This work is given preference over everything else, when it reaches the audit office, and the railway company should be praised for the facility with which it handles its pay-rolls, rather than censured for what seems to be delay, but which, as a matter of fact, is far from being such.

When employees leave the service before the pay-rolls are made up, they are paid by time-check. The amount of the time-check is taken up on the pay-roll as a matter of record, but is taken up only in the "amount" and "deduction" columns, showing the time-check number on the roll and leaving nothing due the employee. The pay-checks are, of course, drawn for only the items appearing in the "amount due" column. When pay-checks or time-checks have been held for a certain period, say three months, and the company is unable to deliver and pay them, they are, for convenience in accounting, canceled and transferred to what is usually termed an "unclaimed wage" roll. Here they are carried for an indefinite period, or until paid. This action greatly facilitates the handling of the unpaid pay and time-check accounts, inasmuch as it leaves very little therein more than ninety days old.

The question of labor distribution should also be taken up in this connection. The time-books, in which are entered the daily time-slips, provide space for the distribution of such time. Immediately after the pay-rolls have been compiled and forwarded, the distribution of each employee's time is drawn off on forms suit-

able for the purpose, and recapitulated in the same manner as the material distributions—i. e., by accounts. This distribution is sent to the office of the Auditor of Disbursements, and, after being checked, is charged on the books of the company to the appropriate operating construction, or other account, and credited to the official preparing the roll which the distribution is made to cover, to whom the pay-roll was charged when it was audited. The process of auditing the labor distribution is so similar to that of auditing the material distribution that further description is unnecessary.

Another phase of the work in the office of the Auditor of Disbursements is that handled in the Statistical Department, which is one of the most important divisions. It is through the statistics furnished that the executives of the company judge the work of their subordinates. An Accounting Department of a railway company may be likened to the reflector of a lamp. Each globe of the lamp is represented by an official of the company. The globes do the work; the reflector shows what they do. The Statistical Department of the Accounting Department is really the reflector; it brings all results together, and reduces them to a point where they may be made to show any information desired by the executives.

The question of what statistics shall be furnished is one for executive decision, and on the executive's decision hinges entirely the size of the department. There is probably no other branch of accounting that differs more on the various roads than this. Some executives think that it pays to divide the expenses of

the line, as well as the earnings, into what are known as "accounting divisions," while others feel that anything beyond a division between operating divisions is false economy. Nearly all of the trunk lines are keeping their accounts separate by operating divisions. An "operating division" is that portion of the road under the jurisdiction of a set of division officials, while an "accounting division" is such further subdivision of an operating division as, in the opinion of the executive or the chief accounting officer, is necessary. In general practice, all branch lines are designated as accounting divisions, and, in a great many instances, the main line of an operating division will be split up into three accounting divisions—sometimes, including branch lines, into as many as ten.

As before suggested, there is a question as to the value of figures showing the results of the operation of an accounting division, owing both to the fact that there is considerable expense attendant upon the compilation, and to the further fact that the bases used for dividing some of the expenses are, at best, but arbitrary. There is some doubt as to whether the figures arrived at for the accounting divisions, on the arbitrary bases used, are worth what it costs to compile them. It is the opinion of the writer that division of expenses between accounting divisions is impracticable, and that the results obtained do not justify the expenses incurred. However, as stated before, the question of whether statistics shall be kept for accounting or operating divisions is one that should be decided by the executive of the company, inasmuch as he is the only man who

knows just what he wants, and it is the duty of the Accounting Department to give him just what he wants.

Most railroads get from their Statistical Department what is generally known as an "operating sheet," on which are embodied all of the operating results. These results are usually shown by divisions and districts—a district being that portion of the line over which a general superintendent has jurisdiction, and comprising from two or three to five or six, or more, operating divisions. These sheets show the division of the operating expenses among the different accounts, as provided in the classification, and also certain other statistical information for each division and district, such as: number of passengers moved one mile; number of tons of freight, both company and revenue, moved one mile; freight and passenger-train mileage; passenger-car mileage; loaded and empty freight-car mileage; caboose-car mileage; miles of road operated; etc., etc. These are what are known as "factors." By the use of these factors we are enabled to obtain units of cost for any given part of the expenses, or any other units we may desire. The units most commonly used in railway statistics, in ascertaining costs, are the train-mile, the ton-mile, and the passenger-mile.

To get the unit of cost per freight-train mile, for instance, we first have to divide the operating expenses between passenger and freight. This is done on an actual basis, so far as possible; where it is impossible to ascertain the actual passenger or freight cost, it is obtained on some arbitrary basis, the one most generally

in use being the passenger- and freight-train mile basis. After the expense incident to freight has been ascertained, and it is desired to arrive at the unit of cost, say, per freight-train mile, the expense so arrived at is divided by the number of freight-train miles, the quotient being the unit of cost per freight-train mile.

The expenses may be divided into as many subdivisions as are thought necessary before figuring the units. For instance, in "conducting transportation" expense it is usually considered practicable to figure units of cost per train-, ton-, or passenger-mile for station service, yard service, engine service, train service, and other conducting transportation expenses. On the operating sheet are usually shown three months' figures —i. e., this month, last month, and the same month last year—in order to show the comparisons.

Some of the units that are usually figured, aside from the units of cost, are: tons per train, tons per car, number of loaded freight-cars per train, number of empty freight-cars per train, freight-train miles per mile of road, tons one mile per mile of road, passengers per train, passengers per car, passenger-train miles per mile of road, passengers one mile per mile of road, etc. There, can of course, be shown, on this so-called operating sheet, any units that may be thought of value. Probably no two roads figure exactly the same units of cost; however, all roads, rendering a regular monthly operating sheet, will figure most of the units cited. These units of cost will come nearer reflecting just what a division official is doing than any other figures, and are a great aid to the chief operating officials as

well as to the executives. It should be remembered that all of these units are figured for each division.

If, on a certain division, the unit of cost per freight-train mile for train service this month is 35.3 cents, and last month was 32.7 cents, the division superintendent in charge of that division is quite likely to be called upon for an explanation of the increased cost of 2.6 cents per train-mile. If this explanation is hard to give, it stands to reason that the division official interested will do all he can to reduce the expenses in the subsequent months. It will be seen from this example that units of cost are an excellent measure of an official's ability.

To make these units of cost of any value, however, it is absolutely essential that a full month's expenses, no more and no less, be included in each month's figures. In order to do this, it is often necessary for the division officials to take up certain items of expense in their monthly returns on an estimated basis. This point can be more clearly explained by an example: Let A represent the road preparing the operating sheet. On a certain division of this road it is obliged, for some good reason, to use permanently the track of another company, B, for a distance of twenty miles, paying for the use thereof one-half of the cost of maintaining and operating it, aside from the cost of running its trains; such joint expense to be borne by A aggregating $10,000 per month. There will be times when, in all probability, it will be impossible for B to render its bill, covering the operation and maintenance of this joint line, promptly, and there may be two or three months

at a time when it will be found impossible to render such bills. Now, if A (the line making the operating sheet) should take B's bills into account just as they are rendered, it will be seen that the units of cost for the division of A on which the joint track is operated would be valueless; in fact, they would be worse than valueless in that they would be misleading. In one month they would have no expenses for the joint line, while in the next month they might have two or more months' expenses.

In order to obviate this difficulty and to make the units of cost of some value, the only method suggesting itself is to take such items into the operating expenses on an estimated basis, provided the foreign-line bill is not received in time to take it in on an actual basis. A great many roads do not follow this practice, but it is indispensable to a road that prepares statistics showing units of cost; and it is certainly good accounting.

This department's duties also include the tabulation of joint facility bills and different associations' bills, such as car service, passenger assocations, rate bureaus, etc. These bills are tabulated in detail. This is done to make sure that no additional expense is included without adequate authority, and also for the detection of other errors. It is a great help to an Auditing Department, and is practically the only way to obtain a complete check on such bills.

Another of its duties is to make comparisons of units of cost between different joint facilities. For instance, if on one division we use jointly with another company a few miles of its track, and on another division we

use jointly with another company a few miles of its track, there are certain items that we pay each line, although the prices charged by each may be vastly different. Take, for example, the cost of icing passenger-cars. One company may be charging us, on an average, 10 cents per car for icing, and the other company, 20 cents per car. The two facilities being on different divisions, the division officials would not be in a position to know of the vast difference in cost, and it is quite safe to assume that the heads of the operating departments at headquarters will not notice it; therefore, the only place to discover such discrepancies is in the Accounting Department, and the only method that suggests itself is that of tabulating the different items of cost. The saving to be effected through this may look small to one not in a position to know, but it should not be forgotten that such a saving, when once effected, is a saving for the entire period during which the property is operated jointly. Taking this into consideration, it will be seen that the saving is no small one, especially when it is known that some leases run for 999 years.

Still another duty of the Statistical Department is the preparation of the locomotive and car performance sheet. This shows in detail the results of operation of each locomotive: how many miles it made, how many tons of coal, cords of wood, or pints of oil it used, and the different units per engine-mile; that is, how many miles were run to the ton of coal, pint of oil, etc., used. Similar information is sometimes worked up for indi-

vidual engineers, and it is a most excellent measure of their ability.

The foregoing are only a few of the more important duties of the Statistical Department. There are many others, which limitations of time forbid me to mention. A Statistical Department must at all times hold itself in readiness to furnish any statistical information desired by the various officials.

An important factor in the auditing of the disbursements of a railway company is the work of the Traveling Accountants. While an attempt is made in the general offices to check, as far as possible, all details of the accounting, the correctness of the distribution depends in a great measure on the original distribution made by the timekeeper, shop clerks, or other division accountants. In many cases, the only way in which it is possible to check certain distributions thoroughly is to be on the ground and in touch with local conditions. No man can be in two places at once; i. e., he cannot be in the general office checking accounts and also on the road looking into local conditions at different points. Hence the necessity for Traveling Accountants.

While the Auditor of Disbursements can outline definitions of accounts and methods to be pursued in the accounting for different propositions on the road, the only way in which he can know that his instructions are being fully carried out is through the use of Traveling Accountants, who, being on the road all the time, can keep him advised as to every particular. The Traveling Accountants should thus enjoy the entire confidence of

the Auditor of Disbursements, and should at all times be very closely in touch with him.

The number and duties of Traveling Accountants on different railroads vary with the system of accounting in vogue. For instance, on a road where the system calls for the transmission to the general office of all of the details of the accounts, regardless of their character—whether material or labor—the need for Traveling Accountants is much less than on a road the system of which does not demand the forwarding to the general office of the entire mass of detail which accumulates each month in the accounting for all disbursements. Regardless of the system in vogue, however, there is always need for one or more Traveling Accountants on any road.

One of the duties of the Traveling Accountant, and perhaps the most important one, is the checking of time. There are certain details of timekeeping which it is impracticable, and often impossible, to check in the general office, regardless of what system is employed, and the only way in which a check on these details may be had is to have a Traveling Accountant on the road for that purpose. For instance, take the checking of engine-men's and train-men's time. The sole way in which this can be done correctly is to check it against the train sheets covering the movement of the men in question, and to check it against the time-table or other approved mileage table, in order to see that the distances allowed are proper. In my opinion, this can best be done through Traveling Accountants. The Traveling Accountants on the line of the road checking

time can, as a rule, save a great deal more for the company than their salaries and expenses. This may seem unreasonable, but when it is remembered that the disbursements of the average trunk-line, through pay-rolls alone, average from ten to twenty million dollars a year, it will be seen that this saving is a very small percentage of the total pay-roll.

It is absolutely essential to have somebody on the road checking this time, inasmuch as employees, while prone to criticise the company and the timekeepers in case their time has been under-allowed, are very slow to report any over-payment. I do not say this in order to convey the impression that the employees, as a whole, are dishonest; but some employees, who are not scrupulously honest, if overpaid two or three dollars, will say nothing about it, thinking that the railroad company had not paid them as much as it should at some other time. While this excuse may ease their pangs of conscience, two wrongs do not make a right, and every such dishonest action is a nail in the coffin in which the guilty person's career will finally be buried.

The Traveling Accountants are also able to suggest many economies on the line. For instance, take shop economies. On one of the lines with which I have been connected it was the practice, in paying the men on pay-day, to blow a shop whistle at a certain hour, and have all the employees quit work and go to a centrally located point to receive their wage-checks. Through the suggestion of a Traveling Accountant, this practice was changed, and the timekeeper delivered the pay-checks to the employees separately in each department.

This one suggestion undoubtedly was the means of saving the company at least $1,000 per month on its pay-roll; that is, the company would derive $1,000 more of labor performed from its employees, with the same amount of money expended, as under the other scheme, inasmuch as it would not, under the last-named scheme, waste fifteen minutes or a half-hour of the time of each employee in paying him. This is not the only case I could mention in which different economies have been suggested by the Traveling Accountants, with the same effect. I should like to add that there is no other method in which these things can be discovered by the Accounting Department, and corrected.

The Traveling Accountant is one of the most important personages in the Disbursements Department, and in consequence he should be a man fully versed in all of the workings of this department. Among his other duties is the teaching of the classification to the employees—that is, the timekeepers, shop clerks, and other distribution men along the line. He is, as it were, an interpreter of the classification; and while we try at headquarters to make the classification as clear as possible, there are always certain employees who do not interpret it as they should.

Another field in which the Traveling Accountants are very valuable is the following: As you all know, in this day of labor unions, the different classes of labor are paid according to certain schedules, and these schedules are some times quite complicated, this being especially true in the case of engineers and firemen. It is not to be wondered at that some of the timekeepers,

who are, at the best, not overpaid, stumble and fall in the interpretation of these schedules. However, it is impressed upon the Traveling Accountants that they must see that the schedule is being properly interpreted at each point they visit; and in this way great good is accomplished.

It has been my endeavor, in the foregoing, to give a general outline of the working of the office of the Auditor of Disbursements, lack of time compelling the omission of many details of interest to the specialist, though likely enough dry reading for the average layman.

THE WORK OF THE FREIGHT AUDITOR

W. F. DUDLEY, ASSISTANT GENERAL AUDITOR, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

What the arteries and veins are to the life, health, comfort, and development of the human body, the means of transportation are to the development and prosperity, the intellectual, social, and material welfare, of the people of this country, and therefore to the power and influence of our government. By reason of transportation facilities the people of each section enjoy what they need of the surplus products of nearly every other section—whether it be the product of the soil, of the factory, or of the press.

The Chicago business man, resident of another state—and there are many such—awakened by the rays of the morning sun shining into his room through window-glass made in Pennsylvania, raises his head from the pillow made in North Carolina, and consults the clock made in Massachusetts. In leaving the bed made in Michigan, he steps upon the rug made in New York—or perhaps upon the tack made in Pittsburg. He doffs his night garment made at home, but from cloth made in New England from cotton produced in Mississippi; he dons his business suit made in Illinois from cloth made in Ohio from wool produced in Wyoming, and, entering the breakfast room on a floor made from boards produced in Georgia, is seated at a table made in Missouri, covered by linen made in Connecti-

cut. As he partakes of the fresh, ripe oranges produced in California or Florida, or of the prime fresh meats dressed, perhaps, in Nebraska from cattle produced in Texas and afterward fattened in Montana, or of the cakes from flour made in Minnesota from wheat produced in Dakota, with alleged maple syrup said to have been produced in Vermont, he reads the Chicago morning papers, as fresh from the press as though just printed in his own town.

Two hours later he sits at his desk in Chicago, perusing orders transported to him in the morning mail for merchandise from his store, or factory, or warehouse. This mail may have been carried to him from the Atlantic coast or from the Pacific coast, from the northern or the southern boundaries of the country, or from beyond the confines of the United States—in fact, from any place favored with good transportation facilities; and to such places, whether they be miles, hundreds of miles, or thousands of miles away, he can forward the desired merchandise called for. These places in turn satisfy his needs, and the needs of his community, by shipping back other goods not produced in his locality, but of which they have a superabundance.

Good transportation facilities have rendered it possible to produce and distribute papers and books—the embodiment of thought and learning—at a cost which renders them accessible to everyone. Congresses and conventions, where able minds can meet to discuss important matters of common interest—whether in the field of art or of science, of religion or of government—to give and take, if necessary, hard knocks in the inter-

est of truth and progress, are made possible by transportation facilities. How can a man better serve his country or his fellow-men than by devoting his time and thought and energies to the interests of this great, but not half-appreciated, matter of transportation—by actively engaging with others in the good work of distributing the good things of this earth, so that, instead of being wasted, they may be utilized and enjoyed?

With us there are steamboats and sailboats, trollies and cables, stages and drays—all useful and helpful in a great many ways. But the great transportation utility, in comparison with which every other and all others fade into insignificance, and which has done more than almost any other agency for the development of our country, and for the material welfare, comfort, and enlightenment of its people, is the American railway, constructed and operated by the great railway companies, and the great and glorious army of American railway employees, with which no man need feel ashamed to be identified.

The variety, extent, and intricacy of important matters, requiring intelligent, punctual, and continuous attention, that are involved in conducting the affairs of a railway company, like the bewildering but beautiful variety of form, color, and detail in vegetable life round about us, are almost incomprehensible, and can be given such attention only by a division and specialization of the work. Good results from the railway companies—which, like the refreshing rains of summer, some, but not all, of the people are too apt to accept as a matter of course and without proper appreciation—do not, like

summer showers, come without human thought or effort, but are the direct result and manifestation of such intelligent, punctual, and continuous attention and action—planned, systematized, and provided for by the central figure of the system, to whom all report, directly or indirectly, and by his representatives, each in his own proper sphere and in proper relation with every other, all working in perfect harmony and with perfect discipline—from the President, the General Manager, the General Superintendent, the General Auditor, the Comptroller, the Treasurer, the Tax Commissioner. the General Freight Agent, the General Passenger Agent, the General Baggage Agent, the Claim Agent, the Fuel Agent, the Stationery Supply Agent, the Chief Engineer, the Superintendent of Transportation, the Superintendent of Motive Power, the General Road Master, the Master Car Builder, the Purchasing Agent, the Superintendent of Bridges and Buildings, the General Storekeeper, the Superintendent of Telegraph, the Train Dispatcher, and the heads of other departments and departmental bureaus or divisions, down to the man whose only subordinates are his own two strong and willing hands.

Upon this occasion we are to consider in a general way one of the branches of the Auditing or Accounting Department—the work of the Freight Auditor, or Auditor of Freight Accounts. Much of the work of the Freight Auditor is based upon, and is a verification (or correction) and continuation of, the work done or started by that man of many superiors, the station agent. In discussing the duties of the Freight Auditor,

we must start at the billing station. A consignor, having delivered freight for shipment to the railway company, together with a shipping-bill in due form, properly describing the freight, and showing to whom it is consigned and at what destination, is given in exchange a bill of lading, or freight receipt, by the station agent. The agent thereupon makes a waybill showing, in accordance with the shipping-bill, the consignor, the consignee and destination, a description of the freight or list of articles, the weight, rate, freight charges, advances, and prepaid. The waybill is dated, bears a designating number, and shows the initials and number of the car in which the freight is to be transported. If the shipment is to be stopped en route to be weighed, to be re-iced, or for any other purpose, the fact is noted on the waybill.

The waybill, to the Freight Auditor, is a document of first importance. It should accompany the freight from the point of origin to the billing destination, and should then be sent by the receiving agent to the Freight Auditor—a correct and complete statement of the service rendered and of the incidents connected therewith. It should bear the notations of each conductor moving the freight, showing his name, the number of his train, and the date of each movement. If the freight is weighed on track scales at the point of origin, en route or at the destination, the waybill must show where and by whom weighed, and the gross, tare, and net weight. If the freight has been transferred en route to another car, the waybill must bear a notation accordingly. If the freight is found at the destination

to be damaged or short or over, the fact should be noted on the waybill. Any question which may arise with reference to a shipment should, so far as possible, be anticipated by the agents, weighmasters, inspectors, and conductors handling the freight, and answered in advance by notation on the waybill before this is sent to the Freight Auditor.

In certain cases, under special conditions and limitations, for the purpose of avoiding delay freight may, by special authority, be moved on "slip-bills" or "card bills," the regular waybills being sent by train or United States mail to the agent at the destination; the slip-bill being attached to the regular waybill by the agent at the destination, and returned with it to the Freight Auditor. The movement of freight on a "*memorandum* waybill," or without a waybill, is regarded by Freight Auditors generally almost in the light of a crime; and to move freight without a waybill, or to suppress from the records and reports a waybill on which freight has been moved, is, in the eyes of the Freight Auditor, about the limit of depravity. If freight is underbilled as to weight, commodity, or class, and is reported, there still remains a chance for detection and correction of the error. But what would be the possibility of fraud and uncertainty were it not for the rigid enforcement of the rules under which forwarding agents are required to waybill all freight—every shipment—and conductors are forbidden to take any freight from a billing station without a waybill, and which require that all waybills on which freight is moved, either with or without charges, shall be duly

recorded, reported, and returned to the Freight Auditor for scrutiny and correction—at the expense of the party at fault, in case any error is found to have been made!

All waybills received, local and interline, must be returned (on most roads daily) by the receiving agents to the Freight Auditor. Interline waybills forwarded of course go with the freight through to the billing destination on a foreign line, and finally rest with the Freight Auditor of such foreign line; therefore the forwarding agent making the interline waybill sends an impression or carbon copy thereof to his Freight Auditor, and (usually) to the Freight Auditor of any intermediate line over which the freight is to pass en route to its billing destination.

The agent at each station renders to his Freight Auditor monthly (or as his instructions may require) reports of freight forwarded and received at his station; also, separate reports of freight forwarded and received at any "prepaid station"[1] over which he has supervision. The agent's "freight forwarded report" includes all waybills made by him during the month, and groups the business to each billing destination, showing the waybill number and date, the weight, freight charges, advances, and prepaid on each waybill; these items being footed in the report to show the total of weight, freight charges, advances, and prepaid, by stations. These totals in turn are carried to a recapitulation sheet, and made a part of the report showing the names of the

[1] A "prepaid station" is one at which no station agency is maintained, and to which, therefore, only prepaid shipments can be waybilled.

stations to which the freight has been waybilled during the month, and the total of weight, freight charges, advances, and prepaid on the billing to each station; these items being footed to show the grand total to all stations during the month. The "freight received report" is made in the same way—to show, grouped by billing stations, the date and number of each waybill, with the weight, freight charges, advances, and prepaid on each waybill received; the total received from each billing station; and, in the recapitulation, the grand total of weight, freight charges, advances, and prepaid on all waybills received from all stations during the month. In addition to this, the Freight Auditor will require from the agent at each junction station where freight is interchanged on interline billing, "junction reports," forwarded and received, of such freight as passes across from one foreign road to another foreign road, on which his line is intermediate. There are other reports and statements required by the Freight Auditor, mostly from station agents, some of which will be mentioned later.

While, as has been intimated, the Freight Auditor is a specialist, his duties being confined to one of the many branches of one of the numerous departments of the railroad, the work of his office is sometimes still further subdivided and specialized; as, for example: Division 1, revising waybills; Division 2, checking and balancing freight reports; Division 3, interline freight settlements; Division 4, apportionment of earnings by states and divisions; Division 5, statistics—the number of tons of freight moved one mile, the rate per ton per

mile earned for such movement, tonnage of the several commodities transported, the compilation of regular and special statements as called for from time to time; Division 6, checking of claims; Division 7, milling and cleaning in transit accounts, etc. Each of these divisions, under the supervision of a chief, is again subdivided, so that, instead of all clerks tackling haphazardly all of the work, each clerk understands just what is required of him. He thus has an opportunity to merit and receive commendation of his efforts in successfully accomplishing his own task, and to earn promotion by demonstrating his ability and readiness to do more than that; or to merit and receive less gratifying attention by a failure to keep abreast with his work.

It is sometimes necessary for the billing agent to make waybills hurriedly. The freight may be brought by a consignor, or be transferred from a connecting line to the forwarding station. only a short time before the departure of the train on which it is desired to make shipment; or the weight of the freight must be ascertained or verified after the shipment leaves the forwarding station. For this and other reasons, the receiving agent, rather than the forwarding agent, generally is held responsible for the correctness of freight charges (but not for the correctness of billed advances, or prepaid) shown in the waybill as returned to the Freight Auditor.

It is the duty of the receiving agent, before making delivery, and thereby losing lien on the freight, carefully to revise the waybill, and correct any error in commodity, classification, rate, extension, or footing of

freight charges; and to communicate, if necessary, by mail or telegraph with the General Freight Department as to the rate applicable. To the amount of freight charges so determined he must add the amount shown by the billing agent on the waybill as advances (being perhaps the amount paid by the billing agent to the agent of the connecting line for transportation of the freight to the rebilling station); and from the amount of freight charges and advances he must deduct the amount shown by the billing agent on the waybill as prepaid, this being an amount collected at the point of origin from the shipper to cover or apply on the cost of transporting the shipment to its final destination. The waybill may disclose by notation some further charge against the shipment—e. g., for transferring freight to another car on account of overloading, for recooperage, for restaking, for feeding in transit, for re-icing, etc. All charges against the shipment in excess of the amount shown on the waybill as having been prepaid must be collected by the receiving agent upon delivery of the freight. In case the amount prepaid exceeds the accumulated charges against the shipment, such excess, if there is any chance for question as to the consignee being entitled to receive it, will, in the absence of any special instruction, be added to the freight charges —thrown into freight earnings, subject to claim.

The receiving agent each day sends to the Freight Auditor such waybills as have been revised, corrected and recorded. Such waybills are, as soon as possible thereafter, scrutinized by the Freight Auditor, checked against the classifications and tariffs, and revised as to

weight, rate, extensions, and footings; and notice is sent to the receiving agent of any errors so discovered. The Freight Auditor's correction notices are numbered and recorded. If the correction notice proposes a reduction in the charges, and the agent accordingly accounts for less than was shown in the waybill as returned by him, the record can be satisfied only by a satisfactory showing that only the corrected amount has been collected, or that proper disposition has been made of the excess. If the notice shows the freight to have been undercharged, the record can be satisfied only by an accounting for the waybill in the current month's "received report" at corrected figures, or for the amount of undercharge in a subsequent month's account under the head of "miscellaneous collections," "storage, switching, etc.," or some such heading which may be provided. On inter-line waybilling the receiving railway company by which freight is delivered to the consignee at the destination is held responsible, like the receiving agent on local billing, for the correctness of the freight charges it so collects; and it is to insure against loss of revenue resulting from possible failure on the part of a receiving road properly to revise interline waybills received by it, that the impression or carbon copy of such interline billing is required by the Freight Auditor from the forwarding agent for the purpose of revision and check against returns from the receiving railway company.

The waybills, as revision is completed, are ready to be passed on from what we have here designated as "Division 1—revising waybills," for use by "Division

2—checking and balancing freight reports," and "Division 3—interline freight settlements." After those divisions are through with them they are passed on for file and custody to "Division 6—checking claims," where they are systematically filed, ready for quick reference, by months, alphabetically by receiving stations, or otherwise.

What a vehicle is the modern freight-car! Load into it the entire furnishings of an ordinary dwelling-house, and it still calls for more. Its capacity, to the uninitiated, is astonishing. The average citizen, halted at the crossing by a passing freight train, sees car after car, and car after car, pass before his tired eyes, until at last, before the caboose appears to relieve the tension, his patience is almost exhausted. Some of these cars, he can but notice, are loaded with coal; others with farm machinery, poles, structural iron, building-stone, etc.; others, with contents concealed by closed doors—in almost endless procession. He regards this gigantic aggregation of rolling-stock, and valuable merchandise in great variety, as a unit—simply as a noisy, dusty, rather disagreeable nuisance of a freight train; and if by chance it should momentarily halt before the caboose has fully cleared the street, thus further impeding his progress for a minute or two, he is liable to entertain a senseless feeling of resentment, and too often foolishly to condole with himself as being one of the many victims of a great corporation. He knows, but does not stop to consider, that each individual one of the thousands of useful articles being moved as freight in that train has been ordered and is needed, expected, and

waited for by someone like himself. But this train is only one of hundreds of trains simultaneously running in all directions, perhaps in seven or eight states, over the railway company's thousands of miles of track. Try to imagine for a moment the number of hundreds of thousands of consignments of freight—the number of needed articles so ordered, expected, and waited for. which at this instant are being transported in all of the trains of the great railway company! While they are not quite as the sands of the sea, or the stars of the firmament, they are very suggestive of them.

Nevertheless, the records of the Freight Auditor must be and are complete as to each and every one of these articles. Raise a question with him, giving waybill reference, as to any individual consignment—a carload of grain, or a small box of soap, or anything else, shipped anywhere in any of these trains on his line at any time during the past six or eight years—and he will, without hesitation, while you wait, locate and show you his record of this particular item about which the question is raised. His files of freight reports and waybills cover each and every shipment.

In what we here refer to as Division 2 the "freight forwarded" and "freight received" reports are checked against each other, and all errors in them are corrected. After all items have been harmonized (most of the errors for correction as to weight and freight charges occur in the "forwarded" reports), the reports are refooted, and the corrected totals are entered on sheets provided for that purpose. These sheets, which for the purpose of description we will designate as "divi-

sion balances," have printed, perhaps down the center, the names of all stations on the division, with appropriately headed columns in which to enter on one side the weight, the freight charges, the advances, and the prepaid on freight received at each station on the division, and on the opposite side the corresponding information for freight forwarded from each station on the division; also the amount for charge against each station on account of miscellaneous collections—for storage, switching, car service, supplemental undercharge collections called for in the undercharge correction notices issued by freight auditor's waybill revisers, etc. These division balances thus congregate from the several reports the items of debit and credit to each station agent, and when completed and balanced, the debit and credit items so shown are reported by the Freight Auditor to the General Auditor for entry on the "stations" ledger.

The "freight received" report will, of course, include some waybills dated the previous month, covering shipments which started from the forwarding station during that month, and which were therefore included in its "forwarded" report; obviously, such bills do not appear in the "forwarded" report of the current month. The "forwarded" report of the current month, especially in the case of long hauls, will, of course, include waybills for some shipments which will not reach their destination until some time during the succeeding month, and which are therefore not included in the current month's "received" report. All of these waybills which lap over in the account from one month to another are

listed by the Freight Auditor in detail on so-called "transit sheets." The "transit" at the close of the previous month is used practically as a supplement to the current month's "forwarded" report, and the "transit" of the current month (that is, the itemized list of waybills in transit at the close of current month) will next month be used practically as a supplement to next month's "freight forwarded" report. In making the "division balances" for the purpose of verifying the month's check of freight reports, etc., the footing of the previous month's "transit" is entered on the "forwarded" side, and the footing of the current month's "transit" on the "received" side of the division balance sheet; that is, the balance is effected on the theory that the total amount of freight charges, advances, and prepaid (each of these three classes of charges is entered and balanced separately) on freight forwarded during the current month, plus the amount on waybills in transit at the close of the previous month, equals the total amount of freight charges, advances, and prepaid on freight received at destination during the current month, plus the amount on waybills in transit at the close of the current month. In other words, the total received, and the total not received, equal the total forwarded, and the figures are grouped accordingly.

One of the advantages of this transit sheet is its exposition of waybills not accounted for by the agent at the destination. Any unusual or apparently unnecessary delay on the part of the agent at the billing destination in accounting for a waybill arouses the inquisitiveness or suspicion of the Freight Auditor, who at

once applies to the car accountant (in the case of carload shipments) for information, obtainable from conductors' reports to the latter, as to the movement of the car. Such investigation may disclose that the car containing the shipment was promptly hauled through to and received at its destination; that the waybill and shipment were received in time to have been included in the "received" report from which the waybill was omitted—that the load was discharged and the car sent away empty from the destination station, or loaded with other freight, before the time for closing the "received" report. This suggests the possibility of something wrong, and further investigation may show that the agent has delivered the freight, collected the charges, and for some improper reason withheld or suppressed the waybill. The early detection and speedy straightening out of any such irregularity as this may save discharge and disgrace to someone in the agent's office, and perhaps loss to the agent or his bondsmen.

The items of debit and credit find their way, in regular course, to the division balances above referred to, and from there to the General Auditor's "stations" ledger. For example: A man in Cleveland, Ohio, wishes to send a box of merchandise to his son in Denver, Colo. He does not wish to have his son called upon to pay any charges on the box. For transportation of the box, at the weight stated, each of the three roads over which it is to pass is entitled to, say, \$2, making a total of \$6. This \$6 the man pays to the Lake Shore & Michigan Southern agent at Cleveland. The Cleveland agent of that railway forwards the box

on a Cleveland-to-Chicago waybill, entering in the waybill \$2 as freight charges, and \$6 as prepaid. The Chicago agent of the Lake Shore & Michigan Southern turns the box over to the Chicago agent of one of the lines running between Chicago and the Missouri River —say, the Chicago, Milwaukee & St. Paul. With the box he sends a transfer slip, or transfer bill, giving all necessary information about the box—who shipped it, where it is to go, whom it is for, etc., and showing the charges as \$2 freight, \$6 prepaid. There is, of course, nothing to be collected by the Chicago agent of the Lake Shore & Michigan Southern; but, on the contrary, that company has collected its own charge from the shipper, and \$4 additional which is intended to be applied on the billing west of Chicago. The \$4 is accordingly paid by the Lake Shore & Michigan Southern agent to the Chicago agent of the Chicago, Milwaukee & St. Paul in junction settlement. The Chicago, Milwaukee & St. Paul agent then forwards the box, in accordance with the transfer slip, on a Chicago-to-Council Bluffs waybill, showing \$2 as freight charges (Chicago, Milwaukee & St. Paul earnings) \$2 advances (the amount retained by the Lake Shore & Michigan Southern from the amount paid by the shipper), and \$6 as prepaid. The Council Bluffs agent of the Chicago, Milwaukee & St. Paul turns the box over to the Council Bluffs agent of the Union Pacific Railway Company, accompanied by a transfer bill giving information as shown in the Chicago waybill, and showing the charges as \$2 freight, \$2 advances, and \$6 prepaid. No collection is to be made by the Chicago, Mil-

waukee & St. Paul agent from the Union Pacific agent, but, on the contrary, he must pay the latter the $6 which was paid by the shipper at the point of origin less $4—the amount of the Lake Shore & Michigan Southern and Chicago, Milwaukee & St. Paul charges. Payment to the Union Pacific agent is made, accordingly, in junction settlement. The Council Bluffs agent of the Union Pacific then forwards the box, in accordance with the transfer bill, on a Council Bluffs-to-Denver waybill, entering in the waybill $2 freight charges (Union Pacific earnings), $4 advances (charges accumulated to the Missouri River), and $6 prepaid (the total amount paid by the shipper). The Denver agent makes delivery of the box, collecting no charges, and takes the son's receipt for it; and the father in Cleveland, perhaps in an almost incredibly short time, considering the distance from Cleveland to Denver and return (for it should be remembered that letters, as well as boxes, have to be transferred), receives a letter of thanks from the son. The Chicago-to-Council Bluffs waybill will in due course reach, and be revised and be found correct, or otherwise, by the Freight Auditor, and will appear in the Chicago "forwarded" report and in the Council Bluffs "received" report.

Freight charges are a debit to the account of the receiving agent, but do not affect the account of the forwarding agent; advances are a credit to the account of the forwarding agent, and a debit to the account of the receiving agent; prepaid is a debit to the account of the forwarding agent, and a credit to the account of the receiving agent. On the Chicago-to-Council Bluffs

waybill, here referred to, the Chicago, Milwaukee & St. Paul Chicago agent will be debited with $6 waybilled as prepaid (he collected the amount in settlement with the Lake Shore & Michigan Southern), and will be credited with $2, waybilled as advances (he paid the amount in settlement with the Lake Shore & Michigan Southern). The receiving agent at Council Bluffs will be debited $2 freight charges and $2 advances, and will be credited with $6 prepaid, in accordance with the waybill, and he is by reason of this credit enabled to pay $2 over to the Union Pacific. If nothing had been prepaid, the Lake Shore & Michigan Southern would have collected its earnings in junction settlement at Chicago; the Chicago, Milwaukee & St. Paul would have collected its earnings, and the amount advanced to the Lake Shore & Michigan Southern from the Union Pacific in junction settlement at Council Bluffs; and the Union Pacific would have collected its earnings, and the amount advanced by it at Council Bluffs, from the consignee upon delivery of the freight. If, under a through-billing arrangement, the Lake Shore & Michigan Southern had waybilled this same shipment through from Cleveland to Denver, the necessity for rebilling, and junction settlements, at Chicago and Council Bluffs would have been avoided; one waybill instead of three would have carried the freight from the point of origin to its final destination, and the distribution and adjustment of charges between the three railway companies would have been effected through the Freight Auditors' monthly interline freight settlement.

On a railway operated by divisions, on which, for statistical or other purposes, the earnings and expenses are ascertained by divisions, the Freight Auditor makes a separate division balance-sheet for each one of such divisions of the road, on which sheet only the forwarding and receiving stations of that division appear. The "received" reports of these stations will include, not only freight from other stations on the same division, but freight from stations on other divisions, and freight received on interline waybilling from stations on foreign roads. Therefore, to effect a balance, the charges on freight so received from points off the division must be provided for on the "forwarded" side of the division balance-sheet. This is done by means of what are sometimes called "made-up sheets," on which are drawn off from the "received" reports all items from each of the other divisions, or foreign roads, and the footings of these "made-up sheets" are entered on the "forwarded" side of the division balance-sheet, thus indicating the amount of charges on freight received from each outside division, and from each foreign road. In the same way, the "forwarded" reports will include, not only freight which has been received at other stations on the same division, but also freight which has been received at stations on other divisions, as well as that which has been received on interline waybills at stations on foreign roads. To effect a balance, this is offset by entering on the "received" side of the division balance-sheet the footings of "made-up sheets" covering such items, which indicate the amount of charges on such freight received by each outside division and

by each foreign road. These "made-up sheets" include all the interline and interdivision earnings—earnings to be divided among the several divisions, or with other railway companies, on a mileage or other agreed basis —and therefore, after being used by "Division 2" (checking and balancing freight reports), are of service to the forces in "Division 3" (interline freight settlements) and "Division 4" (apportionment of earnings by states and divisions), to whom they are transferred.

Up to about the time of the passage of the Interstate Commerce Law, freight originating on one road and destined to a point on another road was handled very generally on local waybilling. The initial line waybilled the freight to the connecting-line junction, collecting its charges in junction account; the connecting-line agent rebilling the freight, and the agent at the destination making collection of freight charges and advances from the consignee, unless the shipment happened to be prepaid. Freight settlements between railway companies were thus confined to the station agents at the junction stations, and the Freight Auditor, in his business, had about as much occasion for intercourse with other Freight Auditors as a shoe-cobbler has need of business intercourse with other shoe-cobblers. The steady growth of interline waybilling—the waybilling through from point of origin to destination; all roads ignoring party lines, so to speak, in their efforts to rush freight through to its destination, and so better to serve the people—has radically changed all this. "Fast freight-line" cars are no longer required to obviate the

necessity of transferring interline freight en route. While not very long ago the Freight Auditor received his own local waybills only, or practically so, he now receives regularly the original waybills of perhaps one hundred and fifty or two hundred through-billing foreign roads for settlement by him in interline freight account.

The pressing need, the absolute necessity, for some agreement or common understanding (of which there was none), as to how settlement of interline freight accounts should be made, resulted in a meeting, on December 7, 1887, of interested auditors, mostly strangers to each other, at the old Grand Pacific Hotel in Chicago. That meeting was the nucleus, and is sometimes referred to as the initial meeting, of what is now the Association of American Railway Accounting Officers, at whose annual meetings practically all of the railways on this continent are represented, and which, through its standing and special committees, and at its annual conventions, has discussed, digested, and arrived at definite and clearly stated conclusions on hundreds of problems in railroad accounts, to the great advantage of all concerned; and which has, among other things, formulated a plan for interline freight settlements which is clear and adequate, and a recognized standard. The Association in 1889 published conclusions, based upon its experience, to the effect that interline billing of freight between remote points—between points on the Atlantic and points on the Pacific—"is practicable and desirable;" and that "neither the direction, the distance, nor the number of

intermediate roads is any hindrance to interline billing on the association plan." It is to be hoped that our friends of the Traffic Departments, between whom agreements are made as to what portion of the joint earnings shall be allotted in interline freight settlements to each of the railway companies in the line, will not misconstrue this, and, instead of providing for division on a percentage or some other simple basis, swamp the Freight Auditor, or build up a great industry in his office, by providing for indiscriminate interline billing, with divisions on a classification or some other complicated basis.

The association plan contemplates the rendering, by the Freight Auditor of the receiving road to the Freight Auditor of the forwarding road and of each intermediate road, of monthly "abstracts" (Association Form No. 104) of all interline waybills received, dated in or prior to the month for which settlement is to be made; to be rendered in time to reach them by the eighteenth day of the succeeding month. The business from each station to each station, and via each junction, is to be shown separately. The abstracts are to be accompanied by "division statements" (Association Form No. 105), summarizing the abstracts, and showing also the division of revenue among the roads interested. The Freight Auditor of the receiving road may also render a "summary" (Association Form No. 110), being a recapitulation of the debit and credit items, and showing the balance of his (received) side of the account. If he receives from his correspondent a similar summary, covering the freight moved in the op-

posite direction, the balance arrived at by combining the two summaries will be the net balance for settlement; or, if the Freight Auditors prefer not to render the summary, they may, after interchange of abstracts and division statements, make up and render an "account current" (Association Form No. 106), being a recapitulation of all debit and credit items on freight forwarded, freight received, "intermediate haul," "correction accounts," etc., and showing the balance subject to draft. Such monthly balances, under the recommendation of the association, are generally considered as subject to sight draft on or before the twenty-fifth day of the succeeding month. In order to facilitate settlements, the abstracts and division statements are in the first instance accepted by forwarding and intermediate roads, as rendered by the Freight Auditor of the receiving road; but the Freight Auditors of the forwarding and intermediate roads will not be content to pass such abstracts and division statements without investigation, and any discrepancies that may be discovered therein are to be brought to the attention of the Freight Auditor of the receiving road in a "statement of differences" (Association Form No. 108). The items shown in this statement will be reviewed by the receiving road, and if the Freight Auditor of this road concedes that the original settlement was in error, he will adjust the error in a "correction account" (Association Form No. 107), to be included in a subsequent monthly settlement.

Each intermediate road collects its own proportion of the joint earnings from the receiving road, regard-

less of any question as to whether such earnings were paid by the consignee at the destination, or prepaid by the consignor at the point of origin. Advances, and prepaid items, on interline waybills are included by the receiving road in its settlement with the forwarding road, and do not enter into the account of intermediate roads. Payments of interline freight balances are made usually only once a month; but in exceptional cases, especially where the traffic moves only or largely in one direction, payments of approximate balances are made weekly, such interim payments being taken into consideration in arriving at the amount for final payment about the twenty-fifth of the succeeding month, to close the monthly account.

The apportionment between roads, by Freight Auditors, each month, of hundreds of thousands of dollars of joint freight earnings on interline waybills is not, like the transcribing of a lawyer's brief, a mere matter of clerical labor; it involves great responsibility. Integrity, ability, reliability, untiring vigilance and inquisitiveness, and conscientious combativeness, are qualities which should not be lacking in the Freight Auditor, and his assistants engaged on this work.

The apportionment of earnings by states (and by divisions, usually, when required) is made on the basis of a mileage prorate. For example: Freight originating at St. Paul, Minn., and waybilled from that station to La Crescent, Minn., would not cross a state line, and the transportation charges (100 per cent.) would therefore be apportioned to earnings in Minnesota; while freight originating at St. Paul, Minn., and waybilled

from that station to Chicago, Ill., would move in three states, and the transportation charges would accordingly be apportioned to Minnesota, Wisconsin and Illinois, at the ratio which the movement in each state bears to the total movement. As in the case of other computations made by the Freight Auditor, it is important that this apportionment should be correct; the figures serve not simply as interesting statistical information, but as the basis for taxation in states where the railway companies are taxed on basis of gross earnings.

Statistics showing the number of tons of freight carried one mile can be compiled by the Freight Auditor from several sources of information. They can be made from the monthly freight-received reports. For example: Taking a vertically ruled sheet, with columns of appropriate width, enter in the several columns across the top of the sheet, as captions, "1 mile, 2, 3, 4, 5, 10 miles; 20, 30, 40, 50, 60, 100, 200, 300, 400, 500 miles." The first item on the freight-report recapitulation is perhaps 150,000 pounds, moved 85 miles to Chicago from Milwaukee; this item would be entered on the sheet: 150,000 pounds in the column headed 60 miles, 150,000 pounds in the column headed 20 miles, and 150,000 pounds in the column headed 5 miles. The next item on the recapitulation being, say, 68,000 pounds, moved from a point 326 miles distant, the entry on the sheet would be: 68,000 pounds in the column headed 300 miles, 68,000 pounds in the column headed 20 miles, 68,000 pounds in the column headed 5 miles, and 68,000 pounds in the column headed 1 mile; and so on, dividing the total pounds by 2,000 to reduce to

tons. Having determined from such computations the number of tons of freight hauled one mile, the rate per ton per mile realized for the movement of the freight can be arrived at by dividing the total amount of freight earnings by the number of ton-miles.

Notwithstanding the facilities provided for inspecting, weighing and handling freight, and the issuance to that most useful and indispensable employee, the station agent, of tariffs, classifications, books of rules, circulars, orders, bulletins, instructions, and cautions printed on blank forms, and the almost constant flow of special and general written, telegraphed, telephoned, and verbal instructions, explanations, mild criticisms, commendations, and pointed questions, sent to the station agent, not only by the Freight Auditor, pertaining to freight and freight accounts, but also by almost every other official, of every department on the system, having any interest in anything at or about the station—notwithstanding this, many claims are presented to the railway company by shippers for overcharges on freight, and for loss of, or damage to, freight. For much of this the station agent, of course, is not responsible; although like Shylock, he is hampered, and is required to take nothing less and nothing more than the exact amount named in the tariffs. It is well for the Freight Auditor, or the Freight Claim Agent, to settle overcharge claims promptly; but it is far better for them to avoid the overcharge in the first instance, by collecting, through the station agent, only what the railway company is entitled to under the tariffs for the service rendered. It is well to set a broken bone promptly, but better still to

prevent the fracture. The station agents, who, as a class, have won and enjoy the confidence and respect of their superior officers, are the railway company's representatives with whom the shipping public come in contact, and much of interest to the companies is contingent upon what they do, or fail to do. Hence, the host of typewriting machines of the Freight Auditor and others, ever ready to hammer out letters to the agents, of "Do," "Do not," "Why did you?" "Why did you not?" And such admonitions are harmoniously accepted and acted upon, without friction or irritation —like the crescendos, fortissimos, and diminuendos signaled by the baton of the autocratic leader of an orchestra.

Some years ago there appeared in print an extended humorous narrative, in verse, credited to Mr. S. A. L. Maginn, entitled "The Station Agent's Woes," the concluding lines of which are as follows:

When death o'ertakes, and beyond he wakes,
And knocks upon the door,
And Old Peter looks upon the books,
To figure up his score,
He trembling asks if "Among the tasks,
In this beautiful land of gold,
Is there no escape from hustling for freight?
Must I do this, as of old?
Have you Superintendents, and General Freight Agents,
Claim Agents, and Auditors, here?
If this be so, I will go below."
Old Peter the while looks down with a smile,
And takes him by the hand,
Saying: "Never fear; there are none of them here.
Come in and join the band!"

As a matter of fact, however, there exists between the Freight Auditor and the station agent the most cordial relations, and the most pleasant intercourse consistent with a strict enforcement of the rules.

"Loss and damage" claims are usually handled by the Freight Claim Agent. The claimant for overcharge will be expected to produce evidence of payment—ordinarily the receipted freight bill bearing the signature of the station agent to whom payment was made. The claim will be given a designating number, and made a matter of record. The Freight Auditor will refer to the waybill, or to his record of it, to see whether it bears a reference to any previous claim and whether the agent has accounted for the full amount shown to have been collected; and will note thereon a reference to the number of the present claim. In case of a car-lot shipment, the waybill for which will cover no other consignment, it may be thought advisable to make the claim reference notation on the "received" report, or the "abstract;" but in the case of less-than-carload freight, the waybill for which may cover several consignments besides the overcharged one in question, the claim reference notation will be made on the waybill, opposite the particular consignment on account of which the claim is made. On some roads the claim would be vouchered or declined by the Freight Claim Agent; on other roads it would be not only checked, but also vouchered, or declined, by the Freight Auditor.

Grain, as it leaves the farm, is frequently not in good condition for the market, requiring cleaning to make it salable to the best advantage. The operator of an

interior mill with capacity to produce more flour, etc., than is required for local consumption, may wish to place his products on the market in the larger cities, in competition with the products of the city mills. This he might be unable to do successfully if required to pay a local rate on wheat from the point of origin to his mill, and another local rate on the flour forwarded from his mill; the city millers being in a position to have wheat for grinding at their mills shipped to them directly from the same points of origin, passing en route through the interior milling town, at the one direct through rate, usually less than the sum of the two local rates, to and from the interior milling point. The establishment of cleaning and milling in transit rates by the railway companies tends to relieve any such handicap on the producers and interior millers of grain. The collection of such transit rates necessitates the opening of "transit accounts" at the intermediate or "transit" stations, by the station agents, under the supervision of the Freight Auditor, in which the miller is credited with the weight of wheat, or other grain, on which he pays transit rates, and is debited with the weight of flour, or other product of wheat, as forwarded to its destination without additional charge—"free on transit account;" or the "cleaner," in the same way, is credited with the weight received on which he pays transit rate, and debited with the weight of cleaned grain forwarded "free on transit account." For example: A miller located at a transit station 200 miles from Chicago may receive, say, 500,000 pounds of wheat from a point 250 miles from Chicago, to be milled in transit for Chicago,

on which he pays the agent at the transit station the Chicago milling in transit rate, covering the entire distance—250 miles—although at the time of payment there has been a movement of only 50 miles, from the point of origin to the mill. The agent credits to him the 500,000 pounds, entering it in his transit account under the head of "grain received;" and some time afterward, when the wheat has been converted into flour, bran, shorts, etc., and such products have been returned by the miller to the agent for shipment to Chicago, their weight will be debited by the latter to the miller in the "milling in transit account," under the head of "product shipped;" and the flour, etc., so charged in the transit account will be waybilled from the transit station to Chicago without charges—"free on transit account." Usually a separate transit account is kept of each kind of grain—the product of one kind of grain not being permitted to be shipped against transit rates paid on another kind of grain—and a separate transit account for each transit destination. Great care must be exercised to prevent "overshipments"—that is, the forwarding of any products as "free on transit account" in excess of existing transit credits created by payment of transit rates on grain received; as in the case of the banker, who accepts the money you deposit with him, and permits you to draw from the bank as much as, but no more than, has been deposited.

Among Freight Auditors of the several railway companies, there is still, in matters of detail, much difference of practice; and the assignment to them of duties is not uniform on all roads. This paper, how-

ever, is intended to convey, in a general way, some idea of the work and methods of the Freight Auditor, or Auditor of Freight Accounts.

VITALIZED STATISTICS

JAMES PEABODY, STATISTICIAN, ATCHISON, TOPEKA & SANTA FÉ RAILWAY SYSTEM

A wise king of olden times said: "Of the making of books there is no end." Had he lived today and known as much of our present civilization as he did of his own times, he would have been justified in including statistics in his averment. Had he chosen to enlarge upon the subject, he might have added that, of the books which are written, few are put to good use; and in this respect the inclusion of statistics would be particularly appropriate.

As generally understood, statistics are the statement of results when expressed in figures; and commonly all tabulations of figures, regardless of their character, are so designated. Such a definition is much too narrow, and, were I making a dictionary, I should rather say that a statistic is the concrete expression of the joint result of the interaction of any group of concurrent forces. I am aware that this definition needs defining, and I hope that I may be able to do this as I proceed.

In this day and generation there is no room for laggards. The honored president of the United States is the best possible expression of this truth. In other words, he is a "statistic," representing in himself the result of the progress made by the American people and the character developed thereunder. His favorite adjective, "strenuous," fitly characterizes one of the

most important elements which make for success under existing conditions. We need on our part so completely to engross and identify ourselves with our work as to constitute ourselves the manifestation of that for which we stand. In other words, we too should aim to be the "statistic" of the thing in which we are engaged; and, to do this, we must represent results.

It will be readily apprehended from what I have said that I have little regard for mere facts which can be made of no service, either because they are without value on the one hand, or because they are out of place on the other. Only when statistics can be employed progressively are they of positive consequence. They may, as serving to satisfy curiosity or furnish data for learned disquisitions, possess a sort of negative value; but for the practical purposes of commercial or other life they must be of a character to indicate the proper direction of future effort. We do not so much want to know that our former conclusions are established by our statistics, as to be able to make correct deductions for the future by means of them; and it is only when taking on this latter character that they may be said to be vitalized.

The extent to which railroad transportation enters into the life of every individual is little realized, even by those directly identified therewith. Some idea of it may be gathered from a few comparisons. We have had it impressed upon us that one of the great burdens we have to bear is the large import tax that we pay upon goods brought to this country, and which in the year 1903 amounted to $284,479,582. The correspond-

ent taxes collected on account of internal revenue, such as spirits, tobacco, etc., amounted to $230,810,124. The total receipts from our postal service (and everybody uses postage stamps) during the same year was $134,-224,443. All other receipts from miscellaneous sources were $45,106,969; so that the grand total of the receipts of the United States for that year was $694,-621,118—an enormous sum, but only a little more than one-third of the amount paid for the service of transportation in the United States during the same year. The total value of all the goods imported into the United States was only a little more than one-half of the amount of the railroad revenues. To bring the comparison closer home, it may be mentioned that the value of the entire wheat crop of the United States, on the basis of one dollar per bushel—and it must be remembered that a very large percentage of that valuation is the cost of carrying the wheat to the market—amounted, in the year 1902, to $1,522,519,891, or considerably less than the railroad earnings of the country for the year in which that crop would be transported. These earnings, for the year ending June 30, 1903, aggregated $1,908,857,826—a sum which, even in these days when millions form the ordinary measure of a man's fortune, one can scarcely comprehend. It is, therefore, no wonder that, in order properly to collect and expend this vast sum, the most careful analysis of ways, means, and methods concerning both income and outgo shall be made; and it is to some suggestions in this line that I now wish to turn.

Railroad statistics fall naturally under two principal

divisions: the one relating to traffic, and the other to operation. So diverse are these, as to both their source and their application, that they are almost wholly unrelated to each other. The more complex, as well as perhaps the more important, of these two branches is that of traffic, although hitherto it has received the less statistical attention. We have spent a great deal of time and money in the analysis of our operating expenses, but we have done very little of that work in connection with our earnings. To be successful, the modern merchant must know exactly what he is making or losing on each class of merchandise handled by him; but until recently there were no railroads—and even now there are very few—that have any accurate idea as to the results of handling any particular traffic. If only the volume of earnings during the present year showed an increase over the corresponding period of the previous year, the result was considered as reflecting credit on the department, and was therefore satisfactory. In former days net revenue was not the concern of the Traffic Department. Gross earnings was the shibboleth of the traffic official; and little wonder, for he was neither charged with the responsibility, nor had he any means of knowing or controlling the profitable relations of receipts and expenditures. It is only within the past two or three years that objection was made by the railroads to the request of the Interstate Commerce Commission for the furnishing of commodity statistics, on the ground that the cost of preparing such data was so excessive as to make it impracticable. This, although erroneous, so far as any necessary expendi-

ture is concerned, affords perhaps the actual, although by no means an adequate, reason why this important branch of railroading should have been so long neglected.

The more progressive of our railroad managers are beginning to see the error of this view, and to realize that information which will enable the Traffic Department to earn an additional dollar is just as valuable as that which shows the Operating Department how to save one. The problem is how this can best be accomplished. The origin of traffic is so widespread, the volume of traffic is so large, and the conditions of traffic are so diverse as to make it manifestly impossible for any general statement to be made, within comprehensible limits, which will afford the directing head of that department the information he needs; and yet it is absolutely essential that he shall have at hand, or within easy reach, whatever it may be necessary for him to know respecting his business. While it is the grand total that he views with chief concern, it is not with the mass that he deals. What may be designated the units of traffic are the things which command his immediate attention, and it is concerning such of these as are of present moment that he needs to be advised. The problem, therefore, is not so much that of accumulation as of segregation; not the gathering together of the millions of transactions which enter into the handling of traffic, but the keeping of them apart, so that, when called for in any form, the necessary combination can be readily made.

Each separate shipment on a railroad is carried on

a waybill, and an abstract is made which recites the essential facts of these waybills, embracing the total of the daily or weekly business of every station on both the forwarded and received side. On the road with which I am connected these abstracts are, by the carbon process, made in duplicate, and a copy is sent by every station to the Statistical Department, thereby giving to it the record of all traffic movements. In this department is prepared, from these abstracts, what is known as a "monthly commodity unit," which represents in a single item the movement of every separate commodity between any two stations on the line, showing origin, destination, weight, ton-miles, and earnings. The abstracts are then filed in calendar order by stations; the monthly units, after being aggregated in certain general ways, being filed by commodities. We thus have at hand in statistical form not only the information ordinarily wanted, but are prepared to furnish almost immediately upon call any information that may be desired.

One or two actual illustrations may serve to make this plain. A certain large firm in a jobbing town in the West, where competition is keen, made application for a reduction of rates from that point into a defined local territory to which, from that point, the existing tariff was prohibitive, and which was therefore supplied from elsewhere. The compensation offered, in event the desired rates were made, was to give to the road from which the concession was asked all the incoming business, which was then being divided among several roads. The problem thus presented was: Will the

additional revenue to be derived from the incoming traffic which the road will then get more than offset the loss caused by the reduction in revenue on the traffic it is now getting? This involved the consideration of a large volume of traffic, moving from many points, at higher rates than would apply if the demand were supplied from the new point of distribution. The Statistical Department was called upon, and, having at hand the information, easily prepared a statement which effectually disposed of the proposition, it being shown that the effect would be, not only to reduce the revenues of the railroad, but also to increase the cost to the consumer.

In another case a stock-raiser wished to make a large immediate movement of a certain commodity, which, because of the long- and short-haul clause of the law, would interfere with existing rates on the same commodity to intermediate points. It was necessary to know at once to what extent revenues would be affected, if the required rate was made. The Statistical Department, through its unit system, was able to give the information in three hours which, under the ordinary method of obtaining such data, would have required three weeks, with the result that a profitable business, which would otherwise have been lost, was secured.

Again, arrangements are being constantly made by the Traffic Department covering large movements of freight; but it frequently happens that shippers for various reasons divert their shipments before the specified amount has moved. It is the business of the Statistical Department to keep watch of such traffic,

which is easily done through the medium of the monthly units of the commodity movements. It is also frequently necessary for the Traffic Department to know the extent of the business of particular shippers; this the Statistical Department furnishes on short notice, through the use of the abstracts which are so filed as to have the record all together. The number of these calls are so great, and their nature so diverse, as to render impossible any compilation in advance which will serve the purpose; but it is found that, through the medium of the commodity units on the one hand, and the segregated abstracts on the other, almost any question regarding the movement of traffic is easily and quickly answered.

It is also valuable to know just what each different class of traffic earns. There is widespread ignorance in this regard, and no little injustice has been done to railroads because of it. In the early days of railroading some man conceived the idea of working out the average earnings per ton-mile—a factor not only useless as conveying any information, but absolutely harmful because of the wrong impression thereby created. During the past twenty years, which embraces the period of governmental railroad regulation, this average ton-mile rate has done yeoman service in the reduction of railway charges. No less an authority than the Interstate Commerce Commission employed it in an opinion wherein a rate prescribed by it was held to be certainly justified, for the reason that it was more than double that of the average rate per ton-mile received by the same road as shown in its annual report,

although, as a matter of fact, it was, from any transportation standpoint, altogether below the standard of reasonable compensation. While, therefore, the statement of average earnings per ton-mile may be positively declared to be not only useless, but harmful, a report of the actual earnings per ton-mile on each separate commodity is a positive benefit. This, when taken in connection with the average distance each commodity is hauled, the average loading of each commodity per car, and the total ton-miles of each commodity moved, furnishes the traffic man with a comprehensive basis on which to formulate his plans for securing traffic.

It will be observed that no mention has been made of passenger traffic. As already stated, we are using statistics not so much as a record of past events as an indication of future possibilities. So far as I have been able to determine, the results of past passenger traffic furnish no prophecy of future business. That is to say, there is nothing which we can get out of the business already carried which will tell us how to get a single additional passenger in the future. We are required by law to furnish certain information to both the state and the national authorities concerning the movement of passengers, and our figures in this connection go far enough only to meet this requirement. Occasionally information is desired by our officials regarding a certain movement; but that is easily furnished from the data we keep for the purposes already referred to, and requires no special treatment.

Operating statistics deal with an entirely different proposition; they relate to expenditure and perform-

ance. The problem which confronts that department of railroad is to handle the business with the greatest practicable facility at the lowest possible cost consistent with economical results. This is a very different proposition from that which confronts the Traffic Department. There transportation is dealt with on the basis of its entire movement from origin to destination. Here consideration is taken of each separate movement en route. Also, the Traffic Department is concerned only with such tonnage as produces revenue, while the Operating Department must take account of all the tonnage moved, which includes not only revenue freight, but what is known as company freight, together with the weight of the cars in which the commodities are transported.

To illustrate: On a dozen shipments from Chicago to San Francisco the Traffic Department takes account of the rate-paying qualifications of each of the articles transported and deals with them, separately as to each commodity, but, for the entire distance, as a single item. This is because of the different rates charged on the various commodities. The Operating Department, however, consolidates all of these shipments into a single item and reduces them, together with the cars in which they are carried, to one common factor. It then takes account by record of each movement; and there are as many items to be considered as there are engines hauling the freight, conductors in charge of it, operating divisions of the road over which it passes, and subdivisions into districts of main line and branches. It is readily apparent, therefore, that two entirely differ-

ent theories of statistics must obtain in the treatment of problems which are so diverse. And just here is the explanation why railroad statistics, as ordinarily compiled, are wholly inadequate for any purpose. It is manifestly impossible to make the data necessary for the intelligent apprehension of the operation of either one department apply to the other; for, so far as the character of the information required is concerned, there is little in common.

It may be well here to point out a serious, as well as a very costly, error which has crept into railroading because of the misuse of inadequate statistics. Those of us who have been connected with, or have studied, railroad operation have heard of late years a good deal of the "operating ratio," which means the proportion of the total receipts of the road paid out for what are known as operating expenses. Men have been employed at high salaries to take charge of operations, because the statistics of the road on which they were previously engaged showed a small operating ratio. No more misleading, as well as unfortunate, idea was ever conceived than that the operating ratio expresses the measure of transporting efficiency. The final test of all railroad operation is the balance-sheet, and it is very possible for a railroad with an operating ratio of 75 per cent., which is not considered commendable, to show a larger balance than would have been the case had its operating ratio been reduced to 60 per cent., which is thought creditable; although, in the first instance, Wall Street would stand aghast, and, in the second, owners of other properties would indulge in a

race to see which could secure the services of the man who had succeeded in reducing his ratio to such a supposedly favorable basis.

To measure the capacity of a transportation official by the operating ratio can easily be shown to be both illogical and unfair. One of the principal factors in the determination of this ratio is gross earnings—something with which the man in charge of operation nowadays has nothing whatever to do. Another important factor is made up of what is known as operating expenses, one of the main items of which is maintenance of way. The amount to be expended on this account each year is determined, not by the transportation official—although he is consulted—but by the Board of Directors, or at least by the Executive Committee, and the official is expected to use the designated amount to the best advantage. Still another important item is maintenance of equipment, and here too the amount is largely determined in the same way; for maintenance includes not only repairs, but also renewals. The general expenses—under which term are included the salaries of the general officers together with their office expenses, and also insurance and the law—are also matters wholly beyond the purview of the transportation official. Thus we have left only those expenditures which come under the head of conducting transportation, over which he has immediate control; and of these a very large proportion are beyond his ken. Such items as superintendence of traffic, advertising, outside agencies, commissions, and to some extent car mileage and loss and damage, amount-

ing perhaps to from 10 to 15 per cent. of the total outlay under this head, are not within his province. It is perfectly plain, therefore, that to make the operating ratio the measure of an official's capacity is doing him an injustice on the one hand, or giving him undue credit on the other. As constituting a standard, it is altogether valueless.

Not only is this the case, but it operates to injure railroad revenues. Any man worth having on a railroad is striving all the while to improve his position, and he will naturally shape his conduct to meet the requirements of promotion. So long as the operating ratio is the standard, regard for his advancement demands that every engine when moved shall always be loaded to its full capacity, and that such capacity shall consist, as far as possible, of loaded cars. Traffic, on the other hand, frequently requires rapid handling, and very often large movement, of empty cars at short notice, in order that business which would otherwise be lost may be secured. It is easy to see that just here is projected a conflict. Lightly loaded trains and fast movement, or the hauling of empty cars under quick orders and for long distances, means an increased operating ratio; and although the result of such movement may serve to increase the net balance at the end of the year, the man's reputation suffers. The trouble is that the revenue which is lost because of failure to perform a service which unfavorably affects the operating ratio does not in any way appear in the accounts. If such lost revenue could be charged up as an item of expense, there would be a very great change in the

method of operation on many roads. This is one of the problems which it is the duty of the Statistical Department to solve.

For many years there have been divergent views as to the best unit to employ in this department for purposes of comparison. The commercial ton-mile, which includes only revenue freight; the net ton-mile, which embraces all freight both commercial and company; the gross ton-mile, which includes the weight of both the car and contents; the car-mile, which considers each individual car as a unit; and the train-mile. which treats as a single item the entire number of cars in each train, have all had their advocates. While it is conceded that no one of them constitutes a perfect unit, it is now generally admitted that the gross ton-mile forms the nearest approach to it.

Selecting, then, the gross ton-mile as the unit of work performed, it is necessary to provide a correlative unit as the measure of the performance of the work. Here, again, variant views are held, and we have the engine-mile, which is the unit of miles run per locomotive; the tractive force, which expresses the theoretical hauling power of the locomotive; and the traction ton-mile, which is the weight on the locomotive drivers multiplied by the miles run. The first, because of the varying size of the locomotives, is manifestly incompetent; the second, because of the extreme divergence of views as to the factors to be considered in its determinations, is of little value; leaving the third, which, although indefinite as to the amount, is, nevertheless, absolutely comparative as

to performance, and therefore the best unit thus far ascertained. Using these two units—to wit, the gross ton-miles as the measure of the work performed and the traction ton-mile as the measure of the force performing it—we have the ratio of both efficiency and economy. If we can increase our gross ton-miles per traction ton-mile, we are adding to our efficiency; if we can do it at less cost, we are progressing in economy.

The most convenient means for obtaining the record of gross ton-miles is from what is technically known as the "conductors' wheel report." This furnishes all the necessary data required for keeping account of car movement, train movement, gross ton movement, and net ton movement, all of which enter into the statistical result. In connection with these movements are kept the records of wages of the train crew, amount of fuel consumed, and other items entering into the train expenses; so that it is easy to determine the work performed by each unit of power, and the relative direct cost of doing it. Into this computation also come the repairs of each locomotive, making it possible to determine in a general way the type of engine best fitted for a given service. In order to encourage fuel economy in the running of locomotives, an individual record is kept of the gross ton-miles hauled per ton of coal used by each engineer, this being posted at the end of each month for comparison and inspection.

In addition to the methods already enumerated, all expenditures on account of operation are summarized under four general heads, namely: maintenance of way, maintenance of equipment, conducting transportation,

and general expenses; which are in turn analyzed and subdivided under fifty-three designations. This distribution is first made as to location—that is to say, the particular part of the line upon which each expenditure is made. Those outlays which, by reason of their general character—such as superintendence, repairs of equipment, etc.—cannot be definitely assigned as to location, are apportioned on the basis of car-mileage or locomotive-mileage on each portion of the road, as may be most appropriate. This distribution is made, not only by divisions of the road, but by main line and branches, so that each portion of the road bears its own proper burden. Having thus ascertained the amounts chargeable against each portion of the road, they are again subdivided as between freight and passenger service on a basis of train-mileage. Against this final subdivision is put the number of engine-miles, car-miles, ton-miles both gross and net, and train-miles, permitting us to compare, in each particular, the work of one month with that of another on each division of the road, as well as on the entire system. By this means is shown the average cost of operation on each separate portion of the road.

It will be readily understood that, having on the one hand the average cost of transportation by divisions, and on the other the actual revenue earned by commodities, we are able to determine, not what it costs us to haul each separate commodity, but whether we are receiving, on any particular commodity, the average cost of transportation over the particular portion of the road on which it moves. I think it will not be disputed

that any equitable adjustment of transportation charges should assign to each principal article of commerce a rate which will at least pay the average cost of transportation; otherwise some commodity is compelled to bear a burden which properly belongs to another.

The value of statistics of this character was recently demonstrated in what is known as the Texas Cattle-Raisers' Case, in which complaint was made to the Interstate Commerce Commission that the rates on cattle from Texas to the markets were too high. To disprove this statement, the movement of a car of cattle was followed from representative points in each of forty-two rate groups in Texas and Indian Territory, both to Kansas City and to Chicago. The average cost of movement over each separate division traveled was computed on the gross ton-mile basis, and it was found that the actual revenue received for such haul averaged nearly $8 per car less than the average cost to Kansas City, and $19.52 per car less than the average cost to Chicago. It was thus conclusively shown, not only that the rates were not too high, but that they were still too low, and that the recent advance of which complaint was made was more than justified.

I do not know that I have succeeded in making plain what I mean by the term "vitalized statistics;" but if I have impressed the idea that statistics, to be valuable, should possess a vital relation to the future, rather than present a mere exposition of the past, I shall feel more than satisfied. If also I have so presented the subject as to prove that, for the proper making and application of statistics in connection with

railroading, a knowledge of all branches is essential—and the more extensive the better—I shall feel that I have more than justified the attempt which is being made by the University of Chicago to provide, by means of this and similar courses, a way by which some portion of that education may be had. I would not encourage the notion that the most thoroughgoing course that can be conceived will give all that is necessary to know for the proper performance of the duties attaching to the statistical or any other department of railroading. Practical experience is the only school which can supply the necessary training in this regard; but it is just such opportunities as are afforded by these courses which will indicate the lines of investigation which ought to be followed. It is probably true that the "Jack of all trades" has had his day, and in his place has come the specialist who seeks to know one thing better and more completely than anyone else; and yet I believe it is true that, specialize as closely as we will, the wider our knowledge in all departments, the better shall we be fitted to attain success in our own particular field of work.

RAILWAY DEVELOPMENT IN CANADA

WILLIAM MCNAB, ASSISTANT ENGINEER, GRAND TRUNK RAILWAY SYSTEM

If a country enjoys the natural advantages of agricultural richness, mineral wealth, forest abundance, and extensive water power, many words will not be needed to demonstrate that its material progress and future prosperity lies largely in its means of communication. This statement is especially applicable to that land which at the present day has the eyes of the world directed toward it—viz., the Dominion of Canada.

Railways, more than all the projects of the arts and sciences, have, in the few years of their existence, completely revolutionized every department of business and social life. With this knowledge, does it not seem almost incredible that there are actually men and women in our respective communities who were living at a time when there was not a single locomotive, not a solitary car, nor yet one mile of railway in the whole of the world? The steel rails over which our great passenger and freight traffic rushes, from one year's end to another, are really bands that bind our whole country together in common facilities of intercourse and transportation.

In the early days of the settlement of Canada (by which I mean the early days of the more modern period) vast sections of the country had to be cleared of bush, and there was an almost wanton destruction of

valuable timber, because facilities for reaching a market were lacking. Of course, such has, more or less, been the experience of all sparsely populated, forest-clad districts. The hardy pioneers, by the tyranny of circumstances, had no option but to fell the great trees, and light what they called their "logging fires," in order to get rid of wood which, if available for the markets of today, would bring untold wealth.

Viewed in the light of today, the isolation in which people lived, in all sections of the country, in these early days, is almost inconceivable. I recently saw a letter which had been written at the Pacific coast in 1843. It was dated Fort McLoughlin, northwest coast of British America, April 24, 1843, and it was exactly one year and six months in reaching its destination—a point fifty miles west of the city of Toronto! Nothing intensifies a truth so much as setting it in the shadow of its opposite; consider, therefore, the mail facilities that are enjoyed today, and the dispatch afforded over 19,000 miles of railway in actual operation within the Dominion—as well as the hundreds more in course of construction, and the thousands projected and about to be built. Of these it is my purpose to speak a little later on.

Railways, it will be admitted, are a potent factor in every movement and operation of national life and expansion; but it is only in such cases as a tie-up for a short time—on account of a gigantic strike, or by reason of extraordinary forces of the elements—that we have our eyes opened to the extent to which the wheels of trade depend for their movement upon the motion of

car wheels. If instances were to be quoted of the cost of conveying freight in the early days, before the great water and rail facilities came to be used, they would be looked upon as almost fictitious.

Although charters for several railway lines in Canada had been obtained as early as 1832, the first attempt at construction was made in 1836, from Laprairie, on the south side of the St. Lawrence River, opposite Montreal, to the town of St. Johns, on the Richelieu River—a distance of eighteen miles. It was called the "St. Lawrence & Champlain," and was intended to be an important link in the chain of communication, then partly existing, between Montreal and New York, by the water route of Lake Champlain and the Hudson river. This date, 1836, was fairly early as far as Canada was concerned, for it should be understood that up to that time only 1,100 miles of railroad were in operation in the whole of the United States. The rails of this pioneer road were of wood, with flat iron spiked to them, which afforded a degree of smooth conveyance scarcely compatible with twentieth-century requirements.

The real epoch, however, during which railway construction in Canada had its serious beginning was between 1853 and 1856. What gave the enterprise a substantial stimulus at that time was an act of Parliament, known as the Guarantee Act, passed in 1849. By this act the government undertook to aid any railway not less than seventy miles in length by guaranteeing the payment of 6 per cent. on a sum not exceeding half the total cost of the road.

A railway, known as the "Atlantic & St. Lawrence," had been projected and was under construction from the city of Portland, Maine, to the boundary line between Vermont and Canada; and in order to connect with this road, and give Montreal direct railway communication with the seaboard, a line, called the "St. Lawrence & Atlantic," was constructed from Longueuil, on the south shore of the St. Lawrence, opposite Montreal, to join the former line by way of St. Hyacinthe, Richmond, and Sherbrooke. It should be borne in mind that the great Victoria Tubular Bridge across the St. Lawrence at Montreal, which was destined to play a most important part in through traffic, had not then been constructed.

In the year 1854 another railway, called the "Quebec & Richmond," was constructed from Point Levi, on the south side of the St. Lawrence, opposite the city of Quebec, to Richmond, on the St. Lawrence & Atlantic line. This was to give Quebec and the East connection with Portland, Montreal, and the West. Sections west of Montreal, such as Montreal to Kingston and Toronto to Kingston (which were originally incorporated under separate charters), as well as the Toronto & Guelph Railway, from Toronto westward and heading off in the direction of Sarina on the St. Clair River, were also being actively pushed forward at about this period.

All of these lines, together with several other sections, were devised with the ultimate object of union, and in due time they were incorporated as one. They virtually formed the backbone, or trunk, of the country;

hence the united roads were called the Grand *Trunk* Railway of Canada. This portion of the present Grand Trunk became the parent stem of the vast system which is today one of the greatest carriers of the commerce of the continent.

The manner of entering into contracts for the surveys and construction of some of these lines was different from that in vogue nowadays. Some substantial contractors, who had engaged in extensive railway construction in England and other European countries, were free just about that time. Their ability and capacity for such work were generally recognized, not only in regard to their engineering qualifications, but also in respect of their financial standing and ability to float the stock. As everything then was only in a sort of experimental stage, it was deemed expedient to make a contract with one firm to make the surveys, acquire the land, and lay out and construct a very large portion of this railway at a rate which would, by their own estimate, give them the same profit that they had made in England and on the continent of Europe.

About the same time another great enterprise was in progress—a railway from the Niagara frontier to the Detroit River. This line stretched out to, and was intended to serve, the southern portions of what may have been looked upon at that period as the great West of Canada—viz., that portion of the Peninsula of Ontario, which lay west of the city of London. It was called the "Great Western." It subsequently built a number of smaller lines as feeders, absorbed others, and became a very important system, as a large share of the

New York–Chicago passenger and freight traffic passed over it.

Still another large enterprise was the Ontario, Simcoe & Huron Railway, afterward called the "Northern Railway of Canada," running from Toronto northward. Like that of many other railways, the original name of this road was changed several times; and it also constructed, as well as eventually absorbed, a number of smaller lines in its particular district, in order to avoid competition and to secure economy in operation.

A number of local lines, occupying the territory northward from Lake Ontario, and stretching northerly and northwesterly toward the Georgian Bay, were chartered and built as separate concerns, but afterward became merged in one undertaking under the name of the "Midland Railway of Canada."

Eventually all of these consolidated enterprises (the Great Western, the Northern and the Midland) disappeared as separate concerns, as one by one they amalgamated with the Grand Trunk, and became permanently incorporated in that extensive system.

The year 1876 saw the completion of the railway from Halifax, Nova Scotia, and St. John, New Brunswick, to what was then the eastern extremity of the Grand Trunk in Canada, namely, Rivière du Loup. This road was intended to unite by rail the maritime provinces or colonies with the rest of Canada, and was on that account called the "Intercolonial." It was built and operated by the government of Canada; in fact, its construction was made obligatory upon the

Parliament of Canada at the time of the confederation of the provinces, now forming the Dominion, in 1867. It has since been extended to Montreal.

Of the 108 railways in the Dominion of Canada some are of considerable magnitude and importance, such as the Canadian Pacific, the Canada Southern, the Canada Atlantic (now part of the Grand Trunk system), the Canadian Northern, and the Quebec Central; but as their inception and construction are of comparatively recent date, their history need not be specially commented upon. Neither need the individual smaller but older railways be accorded special attention in this connection.

The main line of that truly great transcontinental railway, the Canadian Pacific, was completed in 1887, and at once put a large portion of Canada's western wheat-producing area into connection with the seaports of both the Atlantic and the Pacific. It is interesting to note that of all the railways which make up the several systems actually crossing the continent, this Canadian Pacific—the aggregate mileage of all the lines of which is 8,500—is the only one that is at present truly transcontinental. It alone, of all the number, stretches from ocean to ocean under one management. The so-called transcontinental routes in the United States, as is well known, cover several railways, which form, as it were, but links in the long chain.

The great pioneer lines of Canada, from the early days down to the present time, have gone steadily through a process of evolution—in the matter of location, in the method of construction, in the manner of

operation, as well as in the system of maintenance—by which they have reached the state of efficiency in which they are found today, not simply in regard to the territory which obtains facilities in transportation, but in reference to all conditions under which these facilities are secured. The experience acquired by this evolutionary process has, in some instances, been bought at high figures; but it has been experience by which the lines of more modern times, and especially those of the present day, have largely profited—not only by the successes, but also by the failures.

Rails have gone through every conceivable change in shape, weight, length, material, joint, and process of manufacture—from the crude, rule-of-thumb design in iron to the scientifically proportioned shape of the American Society of Civil Engineers' Standard, which is now in use on our larger railways, as well as on many of the smaller ones. At first, after the introduction of steel, that material was very expensive, and the Grand Trunk, as a pioneer road, with little money after its first construction, but with plenty of ambition, experimented with some steel-topped rails—i. e., a top or head of steel formed to fit on to the iron web. But the head frequently cracked, and the scheme proved a failure through the lack of knowledge of a process by which a homogeneous rail could be made by welding a hard head to a soft body.

As the business of the country traversed by the railways increased, cars of greater capacity were needed, and they, in turn, involved the use of larger and more powerful motive power. It is fortunate that the engi-

neers and promoters of the early Canadian roads were liberal in their ideas as to the dimensions and cross-sections of the ordinary roadbed, for up to the present it has been found ample in these points to meet the heavy weights of the present-day rolling-stock. The great, and ever-increasing, weight of the rolling-stock and the loads carried did, however, necessitate the renewal, from time to time with improved design, and on a stronger basis, of the bridge structures. At the present time, on some portions of our Canadian lines, the fourth renewal of spans of 150 feet or thereabout, since the first construction fifty years ago, and due entirely to the greater loads passing over them, is under way. This is another instance of the advantages that lines being built today enjoy from the experience of their predecessors. Each time these renewals were made those in authority no doubt considered they had reached the limit.

When the casual observer is admiring the majestic size, power, and symmetry of one of the largest locomotives of today, there is one feature that may never appeal to him, viz., the far-reaching effects consequent upon using such a machine, beyond the simple fact of its being able to haul the heaviest train. But these effects are a source of much concern to the railway manager, and the question of what size of locomotives is the most economical in connection with the physical condition of the road, as well as its traffic considerations, is one which is now forcing attention in a scientific manner upon the great railway systems. In other words, if a line has certain physical features, and a

certain amount of traffic, having certain definite requirements as to speed, etc., under what conditions does increase of the size of motive power cease to be economical?

It would be a mistake if, when new power is to be procured, the only thing taken into account in determining the size of such power were the greater weight of train such power would haul, and the reduction of the cost of the ton-mile from a transportation point of view exclusively; that is, if the physical fitness of the roadbed for such greater loads were not taken into account, with all that such conditions might imply in regard to so fitting it, as well as the cost of its future maintenance. Traffic in different parts of the country may be varied and fluctuating, and while there can be no doubt of the economy in the use of large power when the traffic is heavy and constant, it may be questionable when such conditions do not wholly exist.

As instance of this, and as illustrative of some of the points which the railway manager must analyze, there are some roads and branches of roads which have a traffic that fluctuates greatly. During certain portions of the year there is all the business that the power can handle; at other times the trains run light. The character of the traffic may be such that a certain number of trains are required, even if the business is light. It will thus be seen that with the use of very heavy engines the cost of roadway maintenance will keep up, even when the traffic is light.

Again, some of these branches were originally inferiorly ballasted, and, in any case, only with such ma-

terial as could be obtained cheaply in the districts through which they passed. In reality, much of it could hardly be classed as ballasting material at all.

Taking all these features into account, these roads get on very well with light engines, which keep the cost of maintenance down to a reasonable figure; but with the use of the heavy power it becomes a necessity to ballast the track with expensive material, and to use heavier rails and fastenings, heavier bridge structures, larger turntables, and larger roundhouses. It therefore becomes a matter for very careful consideration whether, from a financial or earning standpoint, the use of very heavy power is not proving, on some lines, an expensive matter.

Of the bridge structures in Canada which have been rebuilt in recent years, two at least are universally known—the one across the St. Lawrence at Montreal, and the other across the Niagara gorge below the falls.

The predecessor of the former was the famous Victoria Tubular Bridge, erected between 1854 and 1859, and which at the time of its completion was classed as one of the wonders of the world. When it is considered that there were few precedents for the engineers to work upon in regard to important points connected with the construction of this bridge, and that many difficulties had to be contended with for the first time—such as the force of the ice breaking up in the spring, the extremes of temperature, the rapidity of the current and depth of the river—one is bound, even now, to acknowledge the foresight and skill of its designers and builders, especially in regard to the construction of the

piers. It was a single-track structure, and the most sanguine of its promoters never realized that, within thirty-eight years after its completion, traffic conditions and the demands of modern rolling-stock would make a complete new bridge necessary.

The old Tubular Bridge was designed for a rolling load of one ton per lineal foot. In the report made by the engineer at the time of its completion the following significant paragraph occurs:

> It is worthy of remark that it was difficult to make up a train weighing the enormous weight of one ton per foot run; and it was just as much as three large engines could do to propel it. Such a load surely never can pass through the bridge in the ordinary way of traffic.

The present structure is a through pin truss, and was designed for a moving load, in either direction, on each of the two tracks, of two consolidation engines, followed by a uniformly distributed load of 4,000 pounds per lineal foot; also for a moving load, in either direction, on each of the vehicular roadways (which are formed by extensions of the enormous floor beam), of 1,300 pounds per lineal foot.

It may be interesting to recall the fact that the early Canadian railways were originally constructed of broad gauge—i. e., 5 feet 6 inches—while the systems of the United States were mainly standard or 4 feet 8½ inches. It is not necessary to enter into the reasons advanced by the early promoters for the broad gauge; suffice it to say that the difference of gauges caused a great deal of inconvenience to passengers to and from the United States, and hampered the movement of in-

ternational traffic, through the necessity of transhipment at frontier points. As a partial remedy, a third rail was laid on some parts of the lines, notably from Sarnia, opposite Port Huron, Mich., to Buffalo, N. Y.; from Windsor, opposite Detroit, to Suspension Bridge, N. Y.; and from Montreal to Rouses Point, N. Y.; so that both broad- and standard-gauge engines and cars could use the same tracks.

However, in 1872 it was resolved to change the whole of the Grand Trunk Railway to standard gauge. This was done in three sections, each section being changed during one season. But so complete were the arrangements for carrying out the work that the actual narrowing of the track itself caused a delay to traffic of only a few hours on each section. In the intervals between the changing of these several sections, the expedient was adopted, at the point of break of gauge, of lifting the bodies of passenger-cars off their broad trucks, and replacing them on standard ones, and *vice versa*. The trucks, also, of many of the freight-cars were so constructed that the wheels were adjustable to the two gauges.

This method, however, frequently proved uncertain and insecure, and, indeed, all of the devices led to more or less confusion as well as accident. It was, therefore, a most important event when the lines and their equipment became all standard gauge. The other broad-gauge railways soon followed the example of the Grand Trunk. The present Owen Sound Line of the Canadian Pacific (formerly the Toronto, Grey & Bruce Railway) and the Coboconk Branch of the Grand Trunk (former-

ly the Toronto & Nipissing Railway) were originally built of a gauge 3 feet 6 inches.

Among the greatest concerns to a railway, in the matter of economical train service and cost of transportation, are its limiting gradients, as well as its curvature, and in these the forethought of even the most far-sighted of the engineers who located these early railways has proved, in recent years, to have been insufficient to cope with the economic principles of modern methods of transportation. This statement, however, is by no means intended to belittle the knowledge of the great masters of early railroad-building. As compared with the engineers of today, they had meager advantages for scientific training, and had comparatively scant opportunity for working from precedent. It is nevertheless a fact that much of what is in practice now in modern railroading was known in principle to these men.

The greater railway systems of Canada are at present investing large sums of money in the revision and bettering of the physical condition of many portions of their lines, in regard to both alignment and gradients. The amount of business, present and prospective, is carefully analyzed, and, after practical ideas have been formed in regard to future growth and expansion, methods of improvement are devised that will best put the roads in shape to handle economically and expeditiously both present and future business. The value of such improvements to our railways is not so much in what can be saved with the present business, as in the

capacity afforded for economically and properly taking care of future traffic.

As a typical example of such revision, the section of the Grand Trunk between Port Hope and Port Union, Ontario—a distance of forty-six miles—may be cited, as it is quite apparent to the eye of the ordinary traveler. Here, within the last three years, the limiting gradients have been considerably lowered, and, by means of certain deviations in places from the ordinary alignment, a large amount of curvature has been eliminated. The result is that the same motive power can haul over this part of the road about double the tonnage that it could before.

Double-tracking is being pushed on where necessity immediately demands it, and it is worthy of remark that by the summer of 1905 one railway system (the Grand Trunk) will, with the exception of the portion in the St. Clair tunnel, have a double track the whole way from Montreal to Chicago—841 miles—and under one management.

Activity in railway construction is at present being manifested in Canada, especially in the Northwest. Both the Canadian Pacific and the Canadian Northern are extending their systems. Besides, one new enterprise of great magnitude is about to be undertaken. I refer to the Grand Trunk Pacific Railway—a line with an aggregate length of 3,500 miles that is to connect the Atlantic with the Pacific. The surveys over the whole of the territory to be traversed by it are now well under way, and active work of construction will be commenced the coming summer [1905].

This railway will be built according to the most improved modern methods. In this instance the experience of present transcontinental lines will be of help in guarding against conditions which, although they could not be called engineering errors at the time they were put into effect, yet, as has been shown, have since proved to be insufficient to meet the requirements of today, as far as the economics of railway location is concerned. It is seldom that there has been such a gigantic undertaking under one management, and it may be a long time, perhaps, before another such enormous single railway venture will be exploited. The study of the records of construction from time to time, with the many features of engineering interest which will be met with, will be of inestimable value to every engineering student, as well as of special benefit to everyone engaged in the administration of a railway.

The new line will be considerably the shortest route from New York, Montreal, and Chicago to the Orient, and as a commercial and country-developing enterprise it will open up to the markets vast stretches of Canada's grain-producing area; for the line will pass through some of the most productive agricultural lands, as well as some of the finest mining districts, in the world.

It will also present to us new vistas of the picturesque and awe-inspiring; for it is scarcely necessary to be reminded of the fact that Canada, like the United States, is a country of magnificent distances, and that it abounds with every conceivable type of physical feature and natural attraction. Towering mountains and gentle slopes, majestic lakes and picturesque tiny lochs,

mighty rivers and limpid streams, gigantic waterfalls and gurgling brooks, boundless prairies and fertile valleys—nowhere else can these be found in such profusion.

RAILWAY EDUCATION[1]

One of the features of the educational history of the past half-century has been the specialization of education with the object of providing a direct route, not only into the older professions, but also into those newer arts and industries to which the economic and social development of modern times has given birth. So far as our universities are concerned, this utilitarian aim is, after all, in accord with their earliest policy; for the three great faculties of the mediæval institution were law, theology, and medicine—the learned professions *par excellence.* Latin, the foundation study, was, in all probability, rarely pursued for its own sake so much as for the access it gave to the written material of the time, and for its convenience as a means of spoken intercourse between men of different mother-tongues; it was studied, in other words, for much the same reasons that German is studied nowadays. The utilitarian aspect which the higher education of modern days is more and more assuming has therefore a historic justification. Even if this had not been the case, there would have been every reason to suppose that the modern trend of higher education is in accord with the spirit of the times and with the logic of events. The daily activities of mankind have long since become too important to be neglected in the educational world; and it is now realized that the universities may shape their curricula with direct reference

[1] Read before the St. Louis Railway Club, January 12, 1906.

to these, and yet lose little, if any, of the mental development so long considered a monopoly of the humanistic studies. The four years devoted to professional preparation for medicine or for the law are not commonly supposed to have any particularly injurious or warping effect upon the mind of the student; in fact, are conceived to be mentally stimulating and invigorating. Equally harmless and equally beneficial is the mental preparation for other practical pursuits of life; in either case, the chief essential in the arrangement of the educational pabulum is that the various studies shall be handled in a broad and scientific way, compelling, on the part of the student, both analytical and synthetical modes of thought. Thus, in existing universities, we find not only the traditional schools of law, medicine, and theology, but also the modern schools of engineering, architecture, education, journalism, commerce, and the like. In turn, the engineering school divides out into its civil, mechanical, and electrical branches; and so right along the line is to be seen greater and greater indication of the influence of the spirit of specialization, which, after all, is but a response to the demand that education shall adapt itself to the necessities of life.

The number of persons engaged in engineering, in architecture, or in educational work falls far below the number at work in the transportation industry; and yet there has been but little effort to provide technical training for the latter. As a part result of this, the railways are finding themselves today in lack of a sufficient number of men qualified to occupy with digni-

ty and with success the positions of initial responsibility —men who know how to do the right thing at the right time; who show initiative and originality when thrown back upon their own resources; who possess, not merely physical or brute obstinacy, but especially that inflexible mental determination and persistency arising from the realization of the trained mind as to the relation of the individual worker to the collective working. It may be that careful professional training will be of considerable benefit to those destined to attain to the seats of power in the transportation industry; I am inclined to think that it will. The conducting of modern transportation is becoming constantly more and more complex; the day of happy-go-lucky, rule-of-thumb railroading, while not entirely gone, will soon be but a shadow of the past. There is no industry at the moment which demands keener intellect, shrewder wit, and better-trained comprehension; no industry in which the failure of these qualities in its officers and, to no small extent, in its men would be more disastrous to the general interests of the country. The necessity for, and demand for, an adequate supply of these qualities is increasing with the extension of the industry. In sheer self-defense, even from a dividend point of view, the railways of this country will have to pay more attention than they have ever done before to the improvement of the quality of the men they take into their employment. For their own interests, they must stimulate a steady flow of the brightest minds of each rising generation into their service, so that they may have ample choice of selection in filling up the

lieutenancies and corporalships, some of those appointed to which, in turn, will qualify for responsibility as captains and colonels, and, maybe, even as generals of the railway army. There are all varieties of transportation problems; but, without doubt, the most difficult one of all is that of securing competent and trustworthy service.

Let us now address ourselves to the consideration of a remedy for the situation. It seems to me that two kinds of work need to be carried on; the first and the one of primary importance being the development of facilities for technical training in transportation, granting to the various studies included in the same all the dignity of university teaching, and making the transportation school as direct and natural an opening into transportation as the medical and law schools into medicine and law. The second is the more systematic provision of technical education for the men already in the service, the great majority of whom, for many years to come, must necessarily be without the initial training referred to in the earlier part of this paragraph. Much may be said in praise of the work accomplished for employees through the railway clubs and the educational branches of the Railroad Young Men's Christian Association, and in other ways; but more needs to be done, with greater system, and with more pronounced educational results.

I shall give first attention to the former of these two varieties of work.

In connection with this, my proposal is that the railways should directly encourage the extension of trans-

portation-teaching at all of the larger universities. Even in our engineering schools the attention given to the special equipment of the civil and mechanical engineer intending to enter railroad work has been but limited, and, so far as the commercial and operating sides of railroading have been concerned, their portion has been utter neglect. The courses in railway transportation, offered by so many of the universities, have been mere academic exercises, frequently taught by men without any living interest in, or understanding of, the railway organism, in no way affording the requisite technical preparation for a railway career. Such places as New York, St. Louis, San Francisco, New Orleans, and many other university towns ought to have their own schemes; but the development should be greater in Chicago than elsewhere, on account of the unique facilities it affords as the foremost railway center of the country.

The railway companies, as a first and great step, should co-operate in founding in that city a Railway College. The task of establishing the College should not be left to the railways centering on Chicago. The companies of the North, East, South, and West will secure no less benefit from the realization of the project than the first-named. I believe that the College should be placed in academic relation with the University of Chicago, or, if practicable, with all the universities specially interested in the teaching of transportation, because the broadening influence of such association would be a good thing to have environing its students. A mind running in narrow grooves is the worst posses-

sion a practical man can have, for it prevents him from appreciating the scope of his own duties.

One distinctive feature of this College should be the arrangement of the work of its members. The students should follow their classes from the beginning of October until the middle of June, and from that time until the middle of September should be placed out on the railroads, at a small salary, to learn the practical details of the business. They could be used to fill in the odd vacancies which occur during every part of the year, and, even if they did not accomplish much, they would probably earn the small salary assigned. The combination in each year of college life of the theory of the class with the practice of the road would be beneficial, both mentally and morally, to the student. Any inclination to the "swelled head," acquired in the classroom, would be knocked out of him most effectually by his associates in employment. During the whole period of the three months he would be required to submit weekly reports as to the work he was doing, with descriptions of, and observations upon, the same.

Admission to the College should be granted only to youths who have already proved the possession of a certain amount of ability and perseverance by graduating from the four-year course of a high school. Nowadays, with the spread of educational facilities, there is no reason why this requirement should not be enforced. I know of at least one town with barely fifteen hundred population that posssesses a high school offering as strong a four-year course as many places of twenty times the population. In the high school is, or

should be, laid the foundation of a broad culture, upon which the superstructure of railway technology could be raised with confidence. Though not necessary in some branches of the service, it might yet be advisable to add to the educational admission requirements a physical test, which should cover eyesight, hearing, and general condition. Through these requirements there would be some assurance of obtaining the sound mind in a sound body, so essential to the production of the highest results.

The courses of the Railway College should provide training on five different sides—mechanical engineering, civil engineering, electrical engineering, commercial, and operating; all with distinct reference, of course, to railroad work. To effect this, the College should be in close touch with the Engineering Department of the University, so that courses common to railroad and general engineering should not need to be handled in the Railway College, only those courses coming under its direct charge which bear a distinctly railroad aspect; for instance, railway construction, maintenance of way, locomotive construction, locomotive tests, and so forth. The independent establishment of a railway college would necessitate the provision of an entire engineering equipment, and this enormous expense would be largely saved by the cooperation suggested. The students of the engineering side of the Railway College would not only obtain a more comprehensive preparation for this special work of their future employment than would be given in any ordinary school of engineering, but they would also

secure a knowledge of general railway organization and operation through the non-engineering courses, a certain number of these being included in their curricula, which would enable the novice railroad engineers to understand better than they often do, under the present systems of training, the relationships of their respective departments to the general work of the railway. The mechanical man would have some knowledge of track—a necessity, not an accomplishment, in these days, when the problem of high speed and weight of motive power and car equipment is so interlinked with that of track capacity; he would have some knowledge of accounting—sufficient, at any rate, to realize the relation borne by the expenses of his department to those of the whole railway; a thorough understanding of the working necessities of the operating department would form part of his mental equipment; and many other matters that, aside from his work though they may appear to be, would nevertheless be of real advantage to him in the performance of his daily duties.

It has also been suggested that it would be an advantage if railway students, not specializing in engineering, were required to take a certain amount of work in this branch. In fact, the Canadian railways, in the Transportation Department which they have provided at McGill University, Montreal, have arranged for something of this kind to be done. Personally I am inclined to agree in part with this policy, provided it be carried out in moderation, because (1) the training may be of practical value to the future

railroad man, and (2) it insures that each student shall have the benefit of the accurate and scientific training arising out of the study of engineering and correlated subjects.

To turn now to the subjects of the curriculum—and, in doing so, by reason of the limits of my paper, I shall confine my attention chiefly to the railway subjects proper. What railway subjects should be taught in the suggested College? The following technical courses could be given, and should be: Railway Construction, Maintenance of Way, Economic Theory of Railway Location, Railway Terminals, Plans and Specifications of Railway Structures of all kinds, Railway Accounting, Station Returns, Construction and Use of Railway Statistics, Organization, Handling of Traffic—Freight and Passengers, Signaling and Train Service, Motive Power Equipment, Car Equipment, Rate-Making, Government Control of Railways, Passenger Department, Freight Department, Railway Finance, Telegraphy, Corporation Law in its Relation to Railways, Railway Liabilities, Law of Carriers.

The names of the subjects will largely indicate to railway men what would be the work of the classes held therein. For instance, the "Handling of Traffic" course, on its freight side, would deal with the methods of disposing of freight in the out- and in-freight houses and at transfer stations, the work of the yards, way-building and expensing, supervision of fast freight, car service, per diem, and so forth; in each section of the work starting with a general type, then proceeding to description of other methods in use both in this

country and abroad, and finally winding up with such critical work as may be desirable. Accompanying the classroom work would be the actual observation of working methods on railways at points within reach of class visits.

Under the head of "Freight Department" would be handled the organization of the department, duties of officers, solicitation of freight, the industrial agent or commissioner, freight claims, clearing systems, and so forth; the whole course giving a compact survey of the actual work of the department, with due regard to differences of organization, policy, and methods. Classification and rates, it may be added, would be handled in the course on Rate-Making.

In a similarly practical manner each of the other railway subjects would be treated, and, in the hands of competent professional instructors, would both inform and train the minds of the students.

Associated with these railway subjects would be the more general ones of Mathematics, Surveying, Mechanical Drawing, Shop Work, Chemistry, Physics, Economics, and English in all full courses, leading to the degree of "Bachelor of Science in Transportation." Students specializing in one branch or other of railway engineering would not be able to take all of the subjects named in the preceding paragraphs, but such selection would be made as seemed practicable and desirable.

Throughout the whole four years every effort would be made to exclude the incompetent and the idle. What would be the position at the end of the fourth and

succeeding years from the foundation of the College? Each year there would be issuing from the College, at the service of the railways, a picked body of young men, sound in body and in mind, not lacking in either culture or practical knowledge directly in line with their future work—young men possessing already, by reason of several summer seasons of actual railroading, a useful acquaintance with their future duties; men capable of thinking and working; men ready to bring to their duties the accuracy and swiftness of scientific methods, and the discretion and wisdom of the accumulated experience of railroaders of past and present, of both East and West.

My remarks have so far referred to students of the Railway College able to put in the regular four-year undergraduate period. Though it is to be hoped that these would form by far the largest constituency of the College, there are others to be provided for, who possess equal mental qualifications, but, for various reasons, must limit their education to one or two years from the date of graduation at high school. For these the College should present a special arrangement of courses, emphasizing the railroad subjects, and yet giving general training, so that a youth compelled to leave at the end of one or two years' work would be competent to discharge with success the duties of, say, a station agent—a branch of the service in which the railways are particularly weak at present—or of any other suitable position. There are a great many young men drifting into the mind-restraining curricula of the shorthand and business school who, with the oppor-

tunity of a much more broadening kind of education before them, offering a direct opening into the branches of a profession where men, and not machines, are the great need, would be glad to take a one- or two-year course in the suggested College. If there were associated with the College a department of correspondence tuition, these short-course men would continue their technical education after they had entered the service, with advantage to themselves and profit to their employing companies. The ambitious boy, with plenty of determination, but little money in his pocket, could probably find many opportunities of temporary employment—the close relationship existing between the institution and the railways would doubtless secure not a few advantages for such students.

The Railway College, financed by the railways, would place at the disposal of the roads a number of scholarships. It is not difficult to see how the companies might well use these scholarships as one factor in cementing to their service the loyalty of the better class of their employees. Such scholarships could be offered in open competition to the sons of employees fulfilling the necessary educational and physical requirements for admission.

The companies would benefit by the leavening influence exerted by the steady influx of able and broad-minded young men, whose training would enable them to see far above and beyond the petty aims and strifes of unregulated unionism, and who would become natural leaders of thought among their associates. Their influence would strengthen good disci-

pline, encourage amiable relations between men and officers, because there would be a better understanding of one another's duties and responsibilities. The work of the school would have a direct bearing upon the labor problem, as it faces the railway companies today.

A further thought presents itself—namely, that the specialized education of the Railway College would induce in the mind of the future railway man a greater appreciation of his work, a stronger desire to remain in an employment in which his training would be more likely to bring ultimate success than in any other. The greater reliance with which railway officials could depend upon the service of the members of their various departments would be entirely beneficial to the companies. To some railway men, particularly unfortunate in the unsettled temperament of their subordinates, the change would seem almost utopian.

Leaving this attractive picture, allow me to recall to your memory the second kind of work which needs to be carried on under the head of railway-training—namely, as previously stated, the more systematic provision of technical education for the men already in the service.

The organization of this side of railway education must fall under three heads: (*a*) evening schools, (*b*) correspondence tuition, and (*c*) traveling teachers.

Our evening railway classes at Chicago, which are now in their second year, have had considerable success. A number of railways with interests in that city have met the expenses between them, sending, in return, employees to the school on free scholarships. Our

initial difficulties lie to a considerable extent in getting hold of the right kind of material. A considerable portion of the men sent to us reveal no sign of any real desire to better themselves by hard work. Lacking in energy, determination, and foresight, they are soon found among the backsliders. This class of men we do not want; they are not the kind out of which real "railroad" men are to be made—though, no doubt, they ape the title. As experience lends wisdom to the administration of the work, we are hoping to be able to devise some method of selection which will enable the companies to fill up the classes with workers and "stickers." Of course, the conditions to which railway employees are subject render regular attendance at evening classes, with the due performance of home work in connection therewith, a task of difficulty and demanding great perseverance. The company's service, sickness, or other unavoidable cause may compel a man's absence for two or three nights. He loses the connection, his back work has accumulated considerably, and, unless he is gritty, he is apt to become discouraged. But it is the gritty men we want to train, and not the weak-backed ones; so that, if out of every two or three men sent us, under present conditions, we discover one "worth while," the result is encouraging. Our school affords also a temporary abiding-place for another type of man, not without grit or brain capacity, but yet an unreliable student. I refer to the man who measures his education on a strictly cash basis—poorly calculated at that; he does not want to waste his valuable time over any of the broader problems of

railway management and policy, is indifferent to the manner in which the company's business is carried on outside of his own immediate work; with a metaphorical pistol at your head, he (i. e., his attitude, not his words) demands that you prove to him the possession of goods that can be transferred to him in the minimum time and at the maximum advantage of dollars per month to himself. He can see ten dollars per month increase in salary at the end of three months with a very appreciative eye, but is absolutely blind to a hundred dollars per month increase three years hence. Here is a man that wilfully narrows his capacity, and, until something happens to reveal to himself what a fool he is, neither school nor company can hope to do anything with him.

In conducting the evening classes, our plan has been so far to compel every man in his first year to take similar work—traffic man, accounting man, operating man, motive-power man, roadway man, all alike have had to pass through the same course, which gives a general survey of the more important features of the whole organization, work, and policy of the railways. The following is the syllabus of the class as described in one of our circulars:

General Relations and Organization.—Organization: varying types with explanation of the same; work of the different departments; duties of officers in each department; nature of work and responsibility. The relationship of railway corporations to labor, particularly in its organized form. Railroads and government control; tendencies manifested in the policies of various states as to powers conferred upon local commissions; experiences of other countries. Railway taxation.

Passenger Service.—Essentials of the service; passenger rates and facilities of various countries compared with those of the United States; passenger associations. The securing of business; advertising methods; passage tickets, varieties and use; ticket-scalping; returns of agents and conductors. Baggage systems; express service; railway mail service. Problems attaching to the dining-car service, sleeping-car service, suburban and branch-line traffic.

Freight Service.—The in- and out-freight houses; loading and unloading; "through" and "way" cars; C. L. and L. C. L. traffic; cost of handling; use of mechanical aids; transfer houses and their relation to economical train-loading. Classification yards. The billing of freight; record of freight from consignor to consignee; shipper's receipt; bill of lading; way bills, local and interline; freight bill; monthly abstracts and summaries, etc. Supervision of fast freight. Freight claims: origin, treatment, and avoidance. Per diem rules: car service associations; private cars. Freight classification; freight associations and the making of rates. Special traffic. Clearing-house system.

Accounting, Statistics, and Rates.—General methods of accounting; daily and monthly returns; auditing of freight and passenger returns; classification and apportionment of operating expenses. Ton-mile figures; analysis of railroad reports; statistics, methods of collecting and utility; graphic records; statistical reports of Interstate Commerce Commission. Rates: theoretical and actual bases of rates; equal-mileage and cost-of-service theories; the development of rates; group rates; through and local rates; "what the traffic will bear," the basis of rate-making, its meaning; use of arbitraries and differentials; comparison of rates; who shall fix the rate? the question of federal and state regulation of rates.

Track.—Location and construction; embankments, cuts, bridges, and tunnels; ballasting; gauge; ties; tie preservation; concrete and metal ties. Rails: standard varieties; chairs, spikes, and bolts; fish plates; tie plates; supported and suspended joints; broken joints; superelevation; renewal of rails. Stub and split

switches; frogs; switch stands; interlocking switches; double-tracking, advantages and cost; maintenance-of-way staff.

The Locomotive.—Earlier types of steam locomotives and subsequent development; varieties of modern locomotives; their uses; parts of a locomotive; the cylinders; simple and compound locomotives; comparative efficiency of the compound; convertible compounds; the cross compound, four-cylinder compound, tandem compound, balanced compound; the air-brake; various locomotive appliances.

Electric Traction.—Application of electricity to railroads; trolley, conduit, and third-rail systems of power transmissions; the electric locomotive; general considerations.

Car Equipment.—Attention will be given to the development of various types of cars in passenger and freight service, increase in size, and capacity; steel cars. The heating, lighting, and ventilation of cars.

Terminal Facilities.—Description of important passenger and freight terminals; transhipping houses; roundhouses; car-repair shops; sorting-yards; water-tanks; coal-supply stations, etc.

Signaling and Train-Working.—Old methods of train-signaling; transition to mechanical signaling; interlocking and signaling apparatus; power-working of switches and semaphores; block system; telegraphic staff, controlled manual, automatic; the merits and limits of the block system. The work of the train dispatcher; the rules of train-working.

Of course, the treatment of each subject has to be more or less brief, but we have arranged our syllabus so that upon this class a number of more specialized courses can be built. However, it is probable that after the current year our evening syllabus will be modified by dividing up this general course into its component parts, and treating both the elementary and more advanced stages of each part in one continuous

class.[2] This will probably induce the men who are not willing to devote their time to the study of departments of the road other than their own, to put in solid work with the classes; and we are hoping that a year's experience in classes relating to their particular departments will have so broadened them, and have so whet their appetites for more, that they will desire to enter classes dealing with other parts of the railway organization. At least, if this does not happen, the conclusion will then have to be reached that such persons are educationally incorrigible. Under the new plan, if put into effect, the following would be our scheme of courses for the academic year beginning October 1, 1906:

1. The Passenger Department—Two hours (one evening) weekly, nine months.
2. The Freight Department—Two hours (one evening) weekly, nine months.
3. The Accounting Department—Two hours (one evening) weekly, nine months.
4. The Operating Department, I (Handling of Freight and Passengers)—Two hours (one evening) weekly, nine months.
5. The Operating Department, II (Signaling and Train Service) —Two hours (one evening) weekly, nine months.
6. The Mechanical Department—Two hours (one evening) weekly, nine months.
7. The Engineering Department—Two hours (one evening) weekly, nine months.
8. Theory of Railway Location (not open to elementary students)—Two hours (one evening) weekly, nine months.
9. Terminal Facilities (not open to elementary students)—Two hours (one evening) weekly, six months.

[2] A general course, much more elementary in character, will form part of the curriculum, however. It will cater to the needs of young men just entering the service.

10. Railway Law (Law of Carriage)—Two hours (one evening) weekly, three months.
11. Corporation Law—Two hours (one evening) weekly, three months.
12. Railway Finance (not open to elementary students)—Two hours (one evening) weekly, three months.
13. Rate Regulation and Government Control (not open to elementary students)—Two hours (one evening) weekly, three months.
14. Railway Statistics—Two hours (one evening) weekly, three months.
15. Railway Labor—Two hours (one evening) weekly, three months.
16. Railway Conditions (an elementary outline of the whole railway organization)—Two hours (one evening) weekly, nine months.

In time it is quite likely that there will be added to these more general classes a number of special courses treating, in much detail, certain portions of the former. Students will be assisted in the arrangement of their courses, so that they may obtain the greatest advantage from their attendance. In some cases a man would be well advised to attempt but one class at a time, and in hardly any case could more than two classes be carried. The value of each course depends largely upon the amount of outside reading, written reports, and so forth, performed in connection with it, and one evening's class work would usually demand two evenings' individual study. It will be noticed that the work is, to all intents and purposes, purely technical; but facilities are in existence with us at Chicago by which railway students can register in University evening courses in English, French, German, political

economy, political science, history, mathematics, geology, and so on.

Another side of the Chicago railway-education scheme, so far as it affects present employees, is that of correspondence tuition—a department which will probably open next October. This will give the opportunity of the higher training in railway transportation to the young man located, it may be, a hundred miles from "anywhere," and so improve the chance of bettering his position. It is the intention to reproduce some or all of the courses previously named as closely as possible in this correspondence department. The sentimental and material advantages to the correspondence student of membership in and work with a university of international standing are obvious.

At certain points, where classes of forty or fifty employees can be formed, we are hoping to be able to handle some of the courses by the direct instruction of a traveling lecturer. Such a lecturer would have several centers established within accessible distance of one another, and would hold "school" at each one evening a week during, say, six months of the year. He would thus be able to handle ten or twelve centers during the year. With half a dozen energetic and capable young men, of trained ability and with specialized knowledge of their subjects, a wide field could be effectively covered in this way.

In addition to this work of instruction, the Railway College should become a world-famous center of research work. As its testing-plants, appliances, and libraries develop, its faculty and advanced students, in

association with practical railway men, could be constantly devoting attention to the consideration of the improvement of railway facilities in all departments. I should like to see its libraries associated with a bureau of information, which should collect, classify, and make readily accessible the results of the investigations of all countries and all investigators on railway subjects. Thus, if a railway wished to have at its disposal a complete record of past and present experiments and experiences of other railways in the matter of treated ties, it would be able to have drawn up for it by the bureau a succinct account of the same, or could send its representative to the bureau to investigate on the spot, with the help of the officers of the bureau and of the College specialists in that field. Or, if a railway wished to review the methods of handling L. C. L. freight in various parts of the country or abroad, similar facilities would be at its disposal; and so on. The value of the bureau, as administered by a scientific college in this way, and situated in the most accessible city in America, would be immense.

I should like to say much more in explanation of the undertaking which the railways centering on Chicago and the University of Chicago are endeavoring to carry out. There are some difficulties in the way. The least serious one is that of finance. The work proposed to be done is so entirely in the interests of the railway companies, and will contribute so much to their more economical working, that there can be little doubt of their willingness to extend their financial aid to whatever amount is necessary. The an-

nual income required is not really very large—probably never exceeding $100,000 per annum. At present but a fourth of that income is necessary. In fact, it should not be a difficult task within the next five years to secure a permanent endowment for the institution and its work that would provide adequate buildings and equipment, as well as a sufficient annual income for current expenses, thus relieving the companies from annual contributions. But even if the latter were to continue, the co-operation of twenty-five to thirty roads would reduce the quota of each to the insignificant sum of $3,000 to $4,000 a year. With hundreds of trained men graduating each year from the College; with thousands of railway employees enjoying the benefits through evening classes, divisional schools, and correspondence tuition; with the further advantages available in the Bureau of Information and in the experiment of its various plants, each road could depend upon getting good value for its money, even if its individual appropriation were twenty times as much.

A difficulty of more importance than the financial one, though still but temporary, is that of securing suitable instructors. We need men of the highest and broadest mental training, keen in investigation, sympathetic in teaching—men who possess the most desirable academic qualities and qualifications, and at the same time have the practical instinct. We see no other opportunity but to train our own instructors, and this we are proposing to do by taking able university graduates of suitable preparation, placing them for twelve

months or so on the road—a month here, three months there, and so on—engaging in the practical side of the subjects in which they are specializing, studying the different methods in use and their relative values, consulting with, and being advised by, railway men of all grades and all opinions. Furthermore, not only will they do this before engaging in teaching, but, as instructors of the College, they will be expected to keep in touch with movements, in their respective departments, on the railways, making investigation trips on all possible occasions. It has been suggested that the Railway College should be largely staffed by railroad men. Where suitable men of actual road or office experience, efficient teachers and capable of real research work—in short, likely to do credit to the College—could be obtained, such could be made good use of. But the ex-railway man who has "resigned" because of incapacity we do not want; the ex-railway man who has been worked out we do not want; the ex-railway man who is looking for a kind of a retiring allowance in the shape of a nice easy job we do not want. The railway man of trained mind, high capacity, and wide experience, possessing undoubted powers of discipline and exposition, associated with a strong personality, we do want; but we could not get him, for the railways need this type of man for their own service, and are able to pay him anywhere from three to ten times as much salary as we could give him. A careful study of the question has convinced me that the policy of training our own instructors, securing them before they have the opportunity of making high salaries—men who

combine the practical instinct with power of exposition, who possess love for research and are disposed toward teaching—is not merely the only feasible plan, but, except in special instances, the most desirable one.

APPENDIX

APPENDIX

The following papers are a few of the ones worked by students of the University of Chicago railway classes during the session of 1905-6. They are descriptive of certain points connected with the freight service, and will be found to present much interesting information. The papers were prepared in the order they appear, by L. B. Burford, W. R. Owen, W. Haywood, M. H. McEwen, R. H Carleton, and A. G. Beaman, respectively. They are reproduced in the form in which they were orignially submitted to the instructor.

THE DIFFERENTIATION OF DUTIES OF THE OFFICIALS OF THE FREIGHT TRAFFIC DEPARTMENT

The duties of the officers of the Freight Traffic Department are so closely allied that one cannot entirely differentiate them—that is to say, pick out certain duties belonging to one officer alone and not to others. This for the reason that the chief duties of all freight traffic officials are practically all directed toward the same end—the solicitation and maintenance of traffic. The greatest differences lie in extent of authority and in detail work. From the Vice-President in charge of traffic downward, the jurisdiction and duties of the various officials become, as they get lower, more restricted and more detailed.

The duties of the Vice-President and General Traffic Manager (on some roads these two offices are held by separate individuals) are general as well as political in

nature. Details are reduced to a minimum. His chief duty is the direction of the business policy of the road as determined by existing commercial conditions. He keeps a strict supervision of such conditions along the road, as well as away from it, in other parts of the country and abroad—conditions which, if not directly influencing the company's business, are likely to affect it. He is responsible to the President for the maintenance of the company's business at a healthy level, and if there are any adverse conditions working against its interest, it is his duty to find, and to recommend or apply, the remedy. He passes on exceptional conditions which may arise—conditions contrary to, or not within, the established lines laid down for the guidance of his subordinates. He maintains general supervision of rates, local and interline, freight and passenger, as well as percentage allowances of the same to the roads affected. He also passes on claims along policy lines, authorizes issuance of passes, and, in aggravated cases, even handles tracers. His decision and instructions are carried out directly by the Assistant General Traffic Manager, who takes care of the necessary details, and whose position, as his title indicates, is in the nature of a general assistant to the Vice-President.

The Freight Traffic Manager is the official directly in charge of the Freight Department. His authority extends over the entire road and it is his duty to carry into effect the general policy and general rules governing the Freight Department. He must keep in touch with commercial interests along the road and conditions affecting the same, and must endeavor to maintain cordial relations with other roads as well as with large shipping interests. He establishes the interline rate basis with other

roads and percentage allowances on the same. It is part of his duty to pass on policy claims and others of exceptional nature, not sufficiently important to require personal attention by the Vice-President. He also handles tracers in aggravated cases. His recommendation or decision on traffic questions in general is necessary. He reports to the Vice-President through the Assistant General Traffic Manager or directly.

The General Freight Agent is, in the opinion of the writer, the pivotal official of the Freight Department, because he is the officer most directly concerned with the actual workings of the department. He is directly responsible for the proper execution of orders, and his authority or recommendation is required on all freight-traffic questions affecting the part of the road under his jurisdiction. There may be one or two of these officials on a road. The division of duties in the latter case will be, of course, a territorial one. Each has entire charge of solicitation and maintenance of traffic in his territory; makes or cancels rates, local and interline, to and from points in his territory; passes on overcharge claims, also on most loss and damage claims, and his recommendation is generally required too on policy claims. He publishes rate tariffs, circulars, special notices, etc., quotes rates, and handles tracers, refused and unclaimed freight, and the routing of unconsigned freight. He reports to the Freight Traffic Manager.

He has as assistants, in the solicitation and maintenance of traffic, the following regular officers: Assistant General Freight Agents, Division Freight Agents, General Agents, Commercial Agents, and Traveling Agents, generally located at important commercial centers or covering territory with large shipping interests, the business

of which is competitive with other lines. Their duties are purely local to the territory they cover and are chiefly exercised in securing traffic. He has also especially appointed officers made necessary by conditions of especial importance peculiar to certain localities. For example, the Erie Railroad has an Assistant General Freight Agent in charge of coal and coke traffic, whose duties are entirely in connection with these two commodities. The Lake Shore & Michigan Southern has a General Ore and Coal Agent, handling the immense amount of coal shipped west over its lines, and the vast ore shipments east from the Northwest to the iron- and steel-manufacturing points in Pennsylvania and Ohio. The Pennsylvania Railroad has a General Coal Freight Agent, handling the same business; and other roads, tapping the large coal fields, have similar officers.

Railroads having terminals at seaboard points have Foreign Freight Agents there to take care of their foreign trade, whose duty it is to keep in touch with trade situations in foreign countries, and with ocean freight rates, and to facilitate the transfer of freight at seaboard. These officers report to the General Freight Agent. There are many other officers of equal importance, appointed by the railroads especially to take care of some traffic or district of especial importance to them, but the examples mentioned serve to illustrate the extensive authority of the General Freight Agent.

In conclusion, it may be added that the Erie Railroad has been taken as the basis of this paper, and that there are undoubtedly points mentioned which are at variance with conditions on other roads.

RETURNS FROM LOCAL FREIGHT STATIONS

The returns from a local freight station may well be divided into two classes—regular and irregular. The regular reports cover such transactions at the station as are strictly in accordance with the company's rules and regulations, and are necessary for the proper accounting of earnings; the irregular reports cover such special conditions or happenings as are not anticipated in the general rules, and which have or are likely to have a bearing on the business of the company. Under this head of irregular returns might also be placed those reports which are only too regular in the frequency with which they occur, but which would not be necessary under ideal conditions. I refer to "bad order" reports and the like.

REGULAR REPORTS

To the General Auditor.—Agents are required to balance their cash-books which show all cash transactions of their respective stations, and to send cash not needed to make change to the Treasurer daily. These remittances are reported to the General Auditor for the credit of the stations from which they are received.

The station accounts are balanced weekly, and a balance-sheet, together with a detailed statement of all amounts taken into the week's account under the head of "storage, switching, etc.," is sent to the General Auditor. Any corrections which the agent has found it necessary to make in his accounts must be shown on the balance-sheets, so that only the net balance chargeable to the station will show in the totals. A monthly balance-sheet and statement of "storage, switching, etc.," is also sent to the General Auditor. "Storage, switching, etc.," includes switching, storage, car service, icing charges, rents,

and other miscellaneous charges remitted to the Treasurer for credit to the station.

When an agent is duly authorized, on account of freights having been overcharged, taken for company use, etc., to make delivery upon collection of less than the full amount carried in his accounts against it, the balance must be carried on the balance-sheets as "awaiting voucher," and a statement made on the back of the balance-sheet showing from whom, for what amounts, and for what accounts vouchers are so claimed.

Such part of the balance against an agent as is uncollected because freight is short or on hand is carried on the balance-sheets as "uncollected bills for charges on freight," and details of this amount are shown on the back of the balance-sheet.

Freight to be transported for the United States government is not accepted unless accompanied by original and duplicate bills of lading issued by the government; and as collection of charges on this freight is generally made through the office of the General Auditor instead of at destination, the bills of lading are handled with the same care as so much cash. The duplicate bill of lading must be surrendered to the government consignor, and the original sent by express to the receiving agent, who, upon delivery of the goods, sends to the General Auditor the receipted expense bills, bills of lading, and a recapitulation showing the amount of charges on each, the total of all, and the date of balance-sheet upon which he will take credit. These receipted expense bills are received by the General Auditor in lieu of remittances in favor of the credit of the station delivering the goods.

To the Freight Auditor.—The first rule to agents, in regard to their returns to the Freight Auditor, usually reads: "Under no circumstances must an agent forward

freight of any kind without making out and reporting to the Freight Auditor a regular waybill covering it." The waybill constitutes the most important return to the Freight Auditor, and nearly all reports made to him are based upon it.

Copies of all waybills, both local and interline, are sent daily to the Freight Auditor by the billing agent, and the receiving agent sends to the same official all original waybills on hand at his station which have been checked and found to be correct. The original waybill is invaluable to the Auditor of Freight Accounts, as these documents form a veritable history of the shipments which they cover during the time of transportation, and by examination of the bill the Auditor can tell whether or not the company has performed its duty to the shipment and received its rightful compensation for the service.

When baggage is carried on freight trains, it moves on a freight waybill, the regular free allowance being made in the weight and the balance charged for at the rates shown in the baggage tariff. If the charges are paid in cash either at the billing or at the receiving station, notation to that effect is made on the waybill; but if paid by excess-baggage coupons, the receiving agent makes a copy of the waybill and forwards the same, with coupons attached, to the Freight Auditor at the close of the month.

The agent makes a weekly report to the Freight Auditor as follows:

1. A report showing the total amount of freight charges on all waybills received during the week: (*a*) from stations on his own line, (*b*) from stations on foreign lines, and (*c*) total received freight charges per

weekly balance-sheet; also, total forwarded freight charges on waybills made to stations on foreign lines.

2. A report of all interline waybills received from points on foreign lines, and of all interline waybills made to points on foreign lines.

3. From junction stations only, a junction freight report of all interline waybills from stations on a foreign line over his line to stations on another foreign line, his line being intermediate.

4. From junction stations only, a junction freight report of all interline waybills to and from stations on his line, received from or delivered to connecting lines.

5. Junction agents are also required to make reports of any miscellaneous charges made in waybills delivered to connecting lines, if those charges were made after the bill left the forwarding station.

6. A report, from milling and cleaning in transit stations, of all waybills on which milling or cleaning in transit charges have been collected. Original waybills on which transit rates have been collected must be returned weekly to the Freight Auditor with the transit reports in which they are included. Transit reports are made separately for each miller or cleaner and for each kind of grain. They show the amount of each kind of grain received at the station, and the amount of product of each kind forwarded on free billing account of transit rates.

The agent makes a monthly report to the Freight Auditor as follows:

1. Separate reports of all local waybills received from and made to stations on his line and not included in a previous monthly statement. All errors discovered and corrected before the monthly received report is rendered are taken into account in making this report. The fact

that a waybill has been sent to the Freight Auditor or included in a weekly received report does not render it too late to make a correction, provided the waybill has not been included in a previous monthly report. Waybills must be included in freight reports at the corrected figures.

2. Separate statements of interline waybills received from and made to stations on foreign lines during the month.

3. Separate recapitulations of stations from which bills have been received and of stations to which bills have been made showing totals of tonnage, freight charges, advanced charges, and prepaid charges.

4. A report showing the weight and freight charges on the several commodities forwarded and received.

5. Switching and car-service charges are accounted for in the report for the week in which they accrue. The report of switching charges collected must show the date of switching, car numbers and initials, points between which switching is done, commodity, name of party from whom collection is made, date collected, and the amount of charges on each car.

The report of car-service charges collected must show the date of detention, name of party from whom collection is made, car number and initials, whether car is loaded or empty, rate per day, and the amount collected on each car; also state of weather, a matter affecting the charges.

The report of storage charges collected must show date of collection, name of party from whom collection is made, reference to the waybill on which the material was received, basis of charge, and the amount collected.

The agent at a junction station, where foreign lines

perform switching for his line, forwards monthly to the Division Freight Agent a statement showing in detail the service performed by each line, and opposite each car number must make reference to his report, covering "storage, switching, etc.," to the Freight Auditor. At junction stations where switching is performed for other lines in accordance with agreements between the roads and orders received from the connecting line, a report of the service is made to the Superintendent, who prepares bill to cover. A copy of this report is sent to the Division Freight Agent.

To the Fuel Accountant.—Agents at coaling stations make reports weekly to the Fuel Accountant of coal received, coal delivered to engines, and cars rebilled. Monthly they forward an inventory of coal on hand, cars on track, and a balance-sheet. Where coal is delivered to engines working on two or more divisions, a separate report must be made for each division.

To the Car Accountant.—The agent makes a daily report of all cars received at or forwarded from his station and on hand. Cars on hand must include all cars regardless of what service they may be in, and must be carried on the reports every day while at the station. Junction agents, in addition to the above, must report daily all cars interchanged with connecting lines, whether for switching purposes or otherwise. The car number and initials, also the final destination and route of each car, must be given.

IRREGULAR REPORTS

Attention will now be given briefly to an agent's duty under a few special conditions.

In case of loss or damage by fire to property of the company or in its possession, the agent must notify the

General Manager by wire and confirm, giving kind of property, whether partial or total loss, location, date, and cause of fire.

When shippers refuse to ship goods under the terms and conditions of classification, tariff, or rules of the company, the freight must be refused, and the Division Freight Agent or the General Freight Agent should be notified.

When freight is receipted for as being in bad order, report should be made to the Freight Claim Agent.

When stock dies or is crippled in transit, the agent should call a veterinary surgeon to make an examination of the animal. The surgeon's report and bill should be sent to the Freight Claim Agent.

The Freight Claim Agent should also receive reports as follows: (*a*) when perishable freight is received and refused—the report should give the value, why refused and the consignee's whereabouts; (*b*) when unable to find a consignee after communicating with the billing agent; (*c*) when freight has the appearance of having been tampered with; (*d*) when, after sealing and sending forward, cars are discovered unsealed and destined beyond; (*e*) when a connecting line refuses a shipment on account of improper billing, correction should be obtained from the billing agent, but if refused for any other reason, both the billing agent and the Freight Claim Agent should be notified.

Changes in advanced charges or prepaid charges should be authorized by the billing agent or the Freight Auditor, and the Freight Auditor notified when the change has been made.

When stock is shipped on contract, the original contract is sent to the Freight Auditor, the duplicate de-

livered to the shipper, and the triplicate kept for the agent's file.

When waste pipes on refrigerator-cars are unclean, clogged, or otherwise in bad condition, report must be made to the Superintendent.

When freight is received on a slip-bill, the agent should notify the General Superintendent if the regular waybill is not rceived before the shipment.

An agent should report to the General Solicitor, by telegraph, a summary of any summons, complaint, notice, or other legal paper served on him, and should forward by mail the paper and a statement of the date of service, what the suit is for (unless disclosed by the paper), and any facts within his knowledge.

A garnishee summons should be reported to the Legal Department or to the Superintendent, giving the name of the employee garnished, where employed, the person under whom employed, and where he receives his pay.

THE HANDLING OF OUT-FREIGHT AT THE ILLINOIS CENTRAL OUT-FREIGHT HOUSE, FOOT OF SOUTH WATER STREET, CHICAGO

In considering the methods of handling freight employed at this particular freight house, it will be proper to take up first such physical matters as the design of the building, driveway, track arrangements, etc.

The house proper is a brick structure, approximately 1,000 feet in length and 48 feet wide, at the south end of which is a covered platform 25 feet wide and 600 feet long, this giving practically 1,600 feet for the handling of out-freight. The house is located about 400 feet east of the entrance to the yards at the foot of South Water

Street. It has forty-three receiving-doors, in front of each of which is located a five-ton capacity scale for the weighing of freight after being unloaded from the wagon. The offices occupied by the receiving clerks are located so that each office takes care of two doors, one-half of each office being assigned to every door. A noticeable feature about the floor of the house is that on the track side of the house the floor is hardwood and laid longitudinally, this greatly facilitating trucking and consequently effecting economy in expense of handling.

The driveway, extending the entire length of the building, is about 75 feet wide, and is situated on the east side of the house. It is paved with heavy granite blocks—undoubtedly a great aid to teaming during wet weather.

The house tracks, numbering seven, have a total capacity of 238 cars, this including the platform above referred to, although this space cannot be fully utilized because of the fact that the cars have to be "spotted" when set, there being a considerable blank space of wall between the doors on the track side of the house.

For the purpose of operation, the house is divided into three sections, each about 500 feet long, the point of division of each section being called a "relay." One man in charge, with three or four helpers, is stationed at this point to take care of the loaded trucks moving between the sections. The object of this division is to keep truckers as near as possible to their receiving-doors, as otherwise a trucker stationed at Door 3, having a lot destined to a car at the other end of the house, would have to walk about half a mile before he returned to his door, which would consume a great deal of time. The trucker brings his truck-loads to this relay, leaves the loaded trucks

there, and picks up another truck destined to a car in his section, which he delivers to the car; then returns to his door. It is an important duty of the foremen to see that truckers are always handling a truck and not returning to their doors empty-handed. Of course, in the handling of trucks from Section 1 to Section 3, the truckers of Section 2 also handle trucks between those two sections.

The force of the house, and their duties, are as follows: (*a*) One General Foreman, who supervises, not only the handling of out-freight but all other loading and unloading of freight at the Chicago station at South Water Street. Although he is compelled, as a result of this general supervision, to divide his time between the various houses, most of his time is spent in the out-house, as he finds it can be used more profitably there than elsewhere. He is responsible for employing all help. (*b*) One Outbound Foreman, who has charge of the force and general working of the outbound house, reporting to the General Foreman. (*c*) One Assistant Foreman, who assists the foreman in the operation of the house. (*d*) Two Relay-Men, who have charge of the handling of the freight at the points of division of the three sections of the house. (*e*) Thirty-four Receiving Clerks, one at each door. (*f*) Thirty-four Scalemen, one located at each door. (*g*) One Revising or Routing Clerk, whose duty it is to aid the receiving clerks in the proper routing of freight, and to correct any errors which they may make in this regard. (*h*) Thirty Stowmen, one for each run of seven cars, whose first duty in the morning is to open cars, sweep them out, and place across his run the various bridges. His special duty in the evening, just before close of business, is to take up the bridges, and close and fasten the doors of the cars. (*i*) About 140 Truckers, the number

varying, of course, with the amount of business, the fall being considered the busiest season of the year. They are divided into gangs of three and distributed among the various doors open for business. When, however, business is light in the out-freight house, and in the opinion of the General Foreman they can be utilized to better advantage at the in-freight house, they are sent there. (*j*) Two Messenger Boys, whose duty includes the carrying of the shipping tickets from the receiving clerks to the billing office, and other work of a similar nature. (*k*) Two Carders and Sealers, whose duty it is properly to card all cars on the house tracks, and also to see that the cars are properly sealed at the close of business, the actual sealing at night being done by a force of about fifteen men picked from the floor of the house, the sealers simply inspecting seals and keeping records. (*l*) One Special Policeman, who is stationed at the entrance of the driveway, and whose duty it is to keep a lookout for wagons containing a large consignment for one point, in which case he directs the same to the door nearest the location of the car into which it will be loaded.

The actual handling of freight is as follows: The package is unloaded and received at the door of the house by the scaleman, who either loads it directly on a truck, many of which are readily accessible for that purpose, or places it on the floor of the house, as best suits his convenience. The shipping-ticket, showing the list of packages, marks, etc., is delivered by the teamster to the receiving clerk. The scaleman then weighs the package, after which he calls out to the receiving clerk the markings on the same, the town, state, etc. He also gives to the receiving clerk the weight of the package as found by him. The receiving clerk compares the markings,

called out to him by the scaleman, with the shipping-ticket, and if they correspond, he marks on the same the weight given by the scaleman. He then calls out to the scaleman the box number, and inserts on the shipping-ticket the car number and initial, the latter information being before him on the daily loading-sheet. The scaleman marks with chalk on the package the box number given to him, and also the letter of the door at which the freight is received, the latter being done in order to keep a check on the door at which the package is handled. The receiving clerk routes the shipment, when destined to a point on a foreign line, in accordance with instructions from the General Freight Department. One copy of the shipping-ticket, which is in duplicate, is returned receipted to the teamster, the other copy being sent to the billing office. If the shipper provides his own ticket, which is generally the case, the receiving clerk duly receipts for the freight by use of a rubber stamp. For shippers who do not have their own tickets the railroad company has a form of receipt for that purpose. The scaleman then loads the freight of the trucks, if he has not already done so, and wheels the same to the center of the floor of the house, convenient for the trucker. The trucker trucks the freight from his receiving-door to the box number shown on the package, if it is in his section; but if not in his section, he trucks it to the first relay point, as previously explained. The stowman receives the freight from the truckers at the car, sees that it is loaded in the proper car, and packs it in station order (if loaded in a way car). He must take particular care to arrange the freight so as to eliminate, as far as possible, all probability of damage while en route. He also inspects markings on the packages and compares the same with the destination of the

car. Under this system there is no check kept on the trucker delivering the freight into the car, as in the case of the vericheck system.

The handling of lots containing but one or two small packages is accomplished in this way. The scaleman, after marking, places the package near the center of the floor, it being the sole duty of one trucker in each section, provided with a four-wheel truck, to gather up each of these small packages and, if in his section, to place them in front of the run in which the car is located to which the package is destined. The stowman of that run carries the package from that point and stows it in the car. The reason for such handling is obviously that of economizing on labor.

Setting of cars on house tracks.—The cars are set on the house tracks, not only in station, but also train order, they being made up by a switching crew at Welden Island (Fourteenth Street) and placed at the house during the night ready for the next day's business. After they are placed, the yard clerks prepare the loading-sheet for the day, copies of which are placed in the hands of the receiving clerks and others concerned.

Perishable freight.—For the expeditious handling of perishable freight, there are ten doors at the south end of the building which receive nothing but that class of traffic after 2 P. M.; this for the purpose of arranging for the loading of all such stuff before closing hours, so as not to hold it over until the next day. For perishable freight which cannot be loaded out on the day received, a cooler is provided, this being built inside the house.

Special receiving-doors.—A special arrangement is maintained in the out-freight house, which provides one door each for the exclusive use of the following shippers:

Montgomery Ward; Sears, Roebuck & Company; and Butler Brothers. This evidently has been established for policy reasons, as it greatly aids the shippers in question to bring down to a minimum delay to their teams, and thereby to reduce teaming expense. However, this is a very expensive method of handling, so far as the railroad company is concerned, by reason of the increased trucking.

Transfer outbound freight.—Transfer outbound freight is generally handled early in the morning, during which time all the receiving clerks, weighmen, etc., whose doors have not been opened for the day, take a hand in the proper disposition of this freight. However, this business has lately been transferred to Fordham (104th Street).

A fair average of the amount of business handled daily is given as 2,000,000 pounds of out-freight, the transfer freight handled amounting to about 1,400,000 pounds daily. The cost of handling at the Illinois Central is high per ton as compared with other roads, undoubtedly due to the extreme length of the house. The remedy for this would be to shorten the house and to provide more tracks. The loading covers about 220 cars daily. The above figures include Big Four out-freight, this being handled through the same house.

The system used at the present time, and as described in the foregoing, was perfected by the present General Foreman. While one might think more or less confusion would result at the relay points of the house in the way of congestion of trucks, my observation was that everything pertaining to the handling of freight worked very smoothly, and, under conditions as shown, it would probably be difficult to improve upon the system used.

COST OF HANDLING FREIGHT

One of the greatest problems of today in connection with the freight service of a railroad, especially in large centers where ground rent is very high, land very valuable, and space limited, is to keep the cost of handling freight down to the lowest possible figure, and at the same time to do the work effectively and with dispatch.

As regards the workings of a local freight-house, congestion is always expensive, not only in itself, as it causes confusion, interference, conflict, delays, complaints, etc., but also in its after-effects which are experienced in the shape of claims for loss and damage, complaints and possibly loss of business from shippers, etc. Although congestion might be avoided by increasing the facilities for receiving and handling freight, by employing more clerks, truckers, storers, yardmen etc., the cost of handling would by such steps be enormously increased, and as the railway companies are in the business for the money there is in it, the problem is to find the minimum amount of room, facilities, and men that are necessary for the proper and efficient handling of the business, and the proper arrangement of these different factors. Obviously, the consideration of expense eliminated, doubling your force, your room, your depot, your freight-houses, and your yards would double your efficiency and ability to take care of the business, but the additional expense involved would not always justify such measures. The commercial wealth of the country would have to be considerably increased, or the operating expenses and fixed charges of the railroads in some way materially decreased; or, as an alternative, railway rates for the hauling of freight would necessarily have to be increased. As railroads must earn sufficient revenue to defray the expenses of operation,

and also meet their fixed charges—such as taxes, rentals, interest on bonds, dividends, insurance, etc.—it will readily be seen that the handling of goods in the freight-houses in all large and congested centers is an item demanding close economy and surveillance.

This economy is not always obtainable by employing a few men, but in having the necessary number of men with adequate depot room and adjoining track facilities for loading and unloading cars. The problem of the present day is to find the least possible expense necessary to handle the business with promptness and dispatch. It goes without saying that the expense will vary by comparison of one freight-house with another, on the same road and in the same city, or on different roads in the same city, due to the local conditions at each depot, the different kinds of freight handled, and the variability of tonnage handled at each depot, as well as the volume of the tonnage.

Eliminating the labor, or personal, element, we find that the arrangement and manner in which a freight-house is built affects to a large extent the cost of handling freight. I believe that the in-freight and the out-freight should be handled in separate houses—that is to say, under normal conditions, and in large centers. My idea is that, where ground space will permit, the freight-houses should have some uniform proportion of length as to width, according to the business being done; and, where possible, the loading and unloading tracks should be between the in- and out-houses, with a platform between. This would permit greater freedom of movement to the freight-handlers, and would be invaluable in the case of transferring freight, and, I believe, would result in economy, as they could perform their labor more satisfactorily than

under other conditions. The two tracks on either side of the platform in the middle could be so utilized that one could contain the inbound cars to be transferred, and the other the outbound cars to receive the transferred goods.

Of course, natural conditions would affect such an arrangement to a great extent, but the principal factors involved in dealing with the handling of freight are the expense incurred and the volume of outbound freight as compared with the volume of inbound freight. Under the above arrangement the freight office might be situated very advantageously at one end of, and connecting, the two houses, in and out, and the close arrangement of these three principal factors—the in-house, out-house, and freight office—would, I think, work out more economically, on account of their continuity with each other, than if they were all three separate, although within close proximity to each other.

In smaller cities and in country towns the in- and out-freight can be handled satisfactorily in one building, or under one roof; but in large and important commercial centers, like Chicago, Milwaukee, Kansas City, Cleveland, St. Louis, etc.—I think it will be found less expensive to handle the two kinds of freight separately as there is, by virtue of the enormous volume of traffic involved, more risk of shipments becoming mixed, more confusion, more interference, and I dare say more claims arising from the joint handling of in- and out-shipments, than from the separate handling of the two.

However, the handling of in- and out-freight in the same house may be employed advantageously where the principle of two levels can be utilized, such as is the case with the Local Freight House of the Wisconsin Central Railway at Chicago, where there is a viaduct on

a level with the second story of the freight-house, by means of which the in-freight is handled on the second floor and the out-freight on the ground floor, both of which are handled to and from the cars through the same doors on the first floor, the in-freight being elevated to the second or viaduct floor by means of large and powerful elevators. Under such conditions a car can be unloaded and loaded at the same time.

The length and width of a freight-house, in or out, also affects the cost of handling freight. Obviously, on account of the greater trucking space involved, an out-freight house should be as narrow in width as the volume of the business handled will warrant, and in most cases should average about thirty feet wide. An in-freight house, on the other hand, should be as wide and as square as possible, as goods are received from cars in a steadier and more constant manner than is the case with out-freight, which is loaded somewhat spasmodically, and at the will of the shipper, while trains carrying in-freight arrive on certain specified schedules, enabling the freight-handlers to transact their business of unloading in an even and methodical manner. Then again, the in-freight house should be very wide on account of the fact that goods are generally stored in it for several days before delivery is actually taken by consignees, and some goods are not infrequently held over a somewhat lengthy period. Out-freight, on the other hand, is generally, or should be, put in cars and forwarded the day that it is delivered to the railway company. Hence all the width that is necessary in an out-freight house is that which will actually contain shipments in process of being put into the cars. The actual length of the two houses will be determined, of course, by the amount of traffic handled through each.

Another thing that affects the cost of handling freight is the system of "spotting" cars. At a station where business is very heavy in volume, and it is necessary to have six, seven, or eight parallel rows of cars, the process of "spotting" these cars so that they come opposite to each other, door to door, is quite an undertaking, and necessitates an immense amount of switching, as on account of the difference in the length of the various cars they all have to be placed uncoupled. This switching raises the cost of handling freight, but in some cases may be avoided by the adoption of a system of island platforms —i. e., platforms about eight feet wide between each row of cars. Under the latter arrangement, the cars can be set in their rows without uncoupling and there would be practically no switching; but the question that is involved is whether the benefit obtained from the decreased switching are greater than and adequately offset the disadvantages of the increased trucking space and the additional ground area required by the platforms. Six platforms, each eight feet wide, would mean an increased trucking space of from twenty-five to thirty feet,[1] and would compel the company to purchase that many additional feet of right of way. Hence, under some circumstances, the system of "spotting" cars might be the more economical, under other conditions, the island platform arrangement might be the most advantageous. In the case of small cities, where there is only one loading track, the system of continuous sliding-doors would, I think, be more economical than any other, and would do away with the "spotting" of cars.

In large centers, where the out-freight of a railroad is

[1]Twenty-five to thirty feet and not forty-five feet, since without platforms, three or four feet or so must be left between every pair of cars.

of great volume, the manner in which the freight is delivered on the floor of the freight-house affects the cost of its handling. For instance, in the case of an out-freight house, 30 feet wide and 500 feet long, with sixteen receiving-doors on the yard or dray side, and twelve doors on the track side, a teamster comes up to door No. 1 at one end of the house and drops down a box of merchandise on the freight-house floor which is destined, perhaps, to be carried into one of the cars on a run at the other end of the building, say in the run opposite door No. 10. This necessitates the trucker hauling this box the whole length of the freight-house, or nearly 500 feet, which, while he might do so with all possible haste, would still result in his consuming as much time as it would take him to make three trips to runway No. 5, or perchance five or six trips to runway No. 3. Hence this haphazard and random delivery of freight on the floor of the freight-house is a more expensive proposition than if the freight should happen to be delivered at the right door—i. e., the one opposite, or nearly opposite, the run in which the car, that is ultimately to carry the freight, is located.

Now, this could easily be arranged for by stationing a man at the entrance to the receiving-yard, whose duty it would be to stop and inquire of each teamster the destination of the goods he intended delivering to the railway company. This person, who might be termed a "directing clerk," would, upon receipt of such information from the teamster, direct him to the door opposite the run of cars into which his freight would ultimately be carried. In the case of a teamster having a number of different packages for a number of different destinations, two or more doors in the center of the house might be arranged to

take care of these miscellaneous consignments, the object being, of course, to decrease the amount and length of trucking. If there were some other wagons or teamsters at any particular door, each one could take his turn, and the yard could be arranged so that all teams would enter at one end and depart from the other.

In this way, besides the advantages above mentioned, there would be more order and less confusion in the receiving-yard, and the draymen and teamsters would be enabled to transact their business in a quicker manner, and could leave the yard more promptly than under the system of permitting them to drive up to whatever door they see unused. The results that would be derived from the establishment of such a system as this would seem to me to more than offset the trifling expense of the directing clerk's salary. This system would also tend to reduce the number of mistakes occasioned by putting freight in the wrong cars, as freight for a certain run of cars would be placed right in front of that run, and the receiving clerks and checkers, having to familiarize themselves with only certain portions of the geography of their road, would make fewer mistakes, and would be more likely to detect mistakes, if any, on the part of the directing clerk, in case he directed a teamster to the wrong door. Truckers would also be able to accomplish a greater amount of work by reason of having to truck a shorter distance; and the storers would be enabled to do their work more quickly and with less interference from the truckers, especially in the gangways and in the cars, than under the present system, as, on account of the smaller distance involved, the truckers could truck the freight directly to the car intended to contain it, instead of leaving the trucks at the entrance of the run for the

storer to handle. Of course, in arriving at the above conclusions, I have taken into consideration the operation of the out-freight house as a separate proposition, and under the system of "spotting" cars on a track schedule.

As regards the cost of operating long out-freight houses, as against short ones, without the employment of a directing clerk as afore mentioned—in the case, say, of a freight-house 500 feet long—if such a freight-house were to be doubled in length—i. e., to 1,000 feet—it could without doubt handle double the amount of traffic; and if the expense of operation were just doubled, it would cost just as much per ton to handle the freight as before; but the expense would be more than doubled, for the simple reason that the trucking would be more lengthy, more promiscuous, and hence more costly, than for the 500-foot house. It might easily be a common occurrence for a trucker to pick up a truck at door No. 1, push it to door No. 20, some 1,000 feet away, and then pick up a truck at door No. 20 loaded for door No. 2, and so on.

It seems to me a better plan, where a railroad has several divisions entering a city, to have small freight-houses for each division, keeping the in-freight separate from the out-freight, and to have such freight-houses located in different parts of the city; or they might even be quite near each other, within four or five blocks proximity, which, of course, would be determined by the local conditions in any particular city. Take the case of the Chicago, Milwaukee & St. Paul's Chicago local freight station, for example, where the ratio of tonnage of the in-freight to the out-freight is as 5 to 7. Such a road might be very profitably operating two in-freight houses and three out-freight houses, each smaller in size than the in-freight house and out-freight house it now pos-

sesses, and situated within four or five blocks of each other. This would give the railway an in-freight house for each of its divisions entering the city, and the three out-freight houses could easily be assigned to Southwest, West, and Northwest traffic respectively: the shipping public could be very easily educated as to which was the proper one to transact business with. By the adoption of bills of lading, freight notices, and the like, of a different color for each of the different freight-houses, such a system could be made to work very smoothly with all concerned. A directing clerk could be employed at each station, and he could instruct the teamsters as to the proper freight-house to go to, in case they went to the wrong one. As regards the in-freight, the addresses of the different in-freight houses could be printed on the different freight notices, and expense bills of different colors could be used, so that the public would not experience much difficulty in getting familiar with the arrangement.

In regard to the vericheck system, I believe a slight modification—i. e., the substitution of "box" numbers for car numbers—is more satisfactory, accomplishes better results, and causes fewer mistakes, than the absolute car number system. Actual experience has verified this. As the car numbers change from day to day, and are generally long (five figures in length), and as there is a possibility of having two cars of the same number with different initials on the same day, there are naturally more chances for error than in the case of "box" numbers, which are never more than three figures in length, and which would never change, and could for that reason be easily learned and memorized by the receiving clerks and checkers.

The in-freight in larger cities being handled prin-

cipally in the forenoon, and the out-freight in the afternoon, and the out-freight being generally of greater volume than the in-freight, the forces of employees operating the two houses can in some instances be so arranged that they will be employed in greater numbers at the house where they are needed the most during the different periods of the day. For instance, a greater number of men could be employed in the in-freight house in the forenoon; and as the rush in the inbound freight subsided, and the rush in the outbound freight increased, a portion of them could be transferred as the occasion required. But the establishment of such a method of joint working must be done in as flexible a manner as possible, for the reason that there are periods when both the in- and out-freight houses experience an overflow of business at the same time, which might result in congestion. Hence the successful working of such a plan would depend to a large extent upon the general character and physical condition of the in- and out-freight house forces; but under intelligent and competent foremanship I think such an arrangement might be profitably employed, especially where the two houses are in close proximity to each other.

In order to get the best results from the services of freight-handlers, a great deal depends upon the foremen in charge, who should be men of trained experience in handling other men, and who must be familiar with the geographical conditions of their road, and see that freight is loaded in station and division order, and for the right division or junction points.

With reference to the question of wages, care should be used in the selection of men, and they should receive a fair remuneration for their services. This would result

in a better understanding between employer and employee, and there would be fewer vacancies to fill, thus assuring a working force of experienced men. This alone would count for much in point of economy, and the railroads would be the gainer in the greater efficiency of the men.

If it is necessary for the office men of a local freight-house to work all hours of the day and night, as apparently a great many of them do, it seems to me that it would be a good plan to organize the force into three shifts, each working eight hours each. There would not necessarily have to be the same number of men in each shift; the night shift could be much smaller than the two day shifts. The railroad company would be the gainer, in that the men would do better work than under the overtime system. This system of shifts would possibly have a tendency to raise the cost of handling freight, but, on the other hand, would prove of value and economy in the long run by averting losses and preventing claims for damages and overcharges, and prevent much public clamor. If you work your force overtime and do not pay them for it, you may by such means keep the cost of handling freight down to a relatively small figure, but not by proper means; and the men become discouraged and demoralized, and their work is liable to be a little below the standard.

In cases where team track tonnage is used in estimating the cost of handling freight at a station, it necessarily has a decreasing tendency, as there is practically no expense attached to the loading and unloading of team-track business, as compared with the handling of LCL shipments through a freight-house. In only a small percentage of cases does the railway company furnish any

help in the loading and unloading of cars on team track, and necessarily, as far as the railway company is concerned, the cost is but trifling.

In the case of one important freight station with which I am familiar, the cost of handling the in-freight averages about 40.03 cents per ton, and the out-freight about 34.90 cents per ton; which, at the ratio of 7 tons of out-freight to 5 tons of in-freight, would make an average cost of 37.04 cents per ton; while team-track tonnage costs only 3.34 cents per ton.

THE RED BALL SYSTEM OF HANDLING FAST FREIGHT

The intention of the writer of this paper is to illustrate the working of the Red Ball system of fast freight by reference to a particular railway, the Rock Island System being chosen for the purpose.

This fast freight service is designed for carload shipments falling under the following general classifications: all Asiatic freight, or freight destined to or from the Pacific coast, El Paso, or south of El Paso; all perishable freight; all freight in refrigerator-cars under ice; all freight in bond; mixed lots of general merchandise, whether in carloads or less, included in the list of Red Ball commodities. Cars containing freight other than the specified commodities must not be Red-Balled without permission of the Freight Traffic Manager, General Freight Agent, or General Superintendent through the Assistant to Second Vice-President.

About seventy stations have been named as Red Ball billing stations; each being designated by letter or letters, and assigned a series of numbers to be used in numbering the envelopes carrying the waybills for the cars. On each

side of every car is attached a card (in size 7 by 9 inches) with a circle filled in with red, on which is set in white the number of the train in which the car is to travel. These cards are of course removed at destination.

A special envelope, also red in color, must accompany each car of Red Ball freight, and every empty car that may be handled as such. The envelope covering the car for the nearest destination is given the opening symbol number, and the envelope for each succeeding destination is given succeeding numbers consecutively in the same order. For example, Chicago forwards Red Ball freight on a train as follows: 1 car for Davenport, 2 for Des Moines, 2 for Council Bluffs, 2 for Denver, etc. The opening number 1 should be given the car for Davenport, 2 for Des Moines, and so on, and the opening number for the next envelope for Red Ball freight from Chicago would be 8. The envelope would of course bear the Chicago symbol FM.

Before the train leaves a Red Ball station, the agent compiles a "consist report" from the information shown on the Red Ball envelopes, and this report must be wired to the General Superintendent within an hour after the departure of the train. This report gives the symbol letter and number, car number and initial, contents, consignee and destination, and, in case the latter is beyond the company's line, the junction point where the car leaves and the routing beyond.

Each agent, at the close of each day, must file with the operator for transmission, forwarding a copy by first passenger train, a report of all Red-Balled cars on hand that were ready to go forward prior to the departure of the Red Ball train upon which they should have moved. This report, besides car numbers, initials, contents, and

destination, gives the hour received and the cause of delay; a supplementary report gives the date and train forwarded.

Whenever a loaded Red-Balled car is set out, a form known as "set-out car" is made out and attached to the face of the red envelope traveling with the car. This form is of a green color and mucilaged for convenience in attaching to the envelope. It is left, with the envelope attached, by the conductor with the telegraph operator at the point where the car is set out, and the information is at once wired to the General Superintendent. If the car is set out at a blind siding, the report will be left at the next telegraph station, and the agent at that point must immediately inform the proper officials. A car once set out for any cause and held for another train must not again be set out except on account of being in bad order. If the freight is transferred to another car, the necessary information is entered on the red envelope, but no change is permitted in the original symbol letter and number, which must identify the shipment to its destination.

Reports previously alluded to have provided for complete information in regard to the shipments—i. e., consignee, commodity, etc.; but the "set-out car" report provides only for train and car symbols and numbers. This is true also of any new reports hereinafter alluded to, as a car, after once having left the billing point, is known by symbols only.

When a delayed car is forwarded, agents or yardmasters advise the General Superintendent by wire, stating the symbol number of the car and the new train number. A report is not required if a car, set out, is forwarded on the same train and date on which it arrived at a station.

Agents or yard-masters at district terminals and other designated stations must wire the General Superintendent of the passing of trains and cars bearing the Red Ball freight. This report states only the lowest and highest symbol numbers of the letter on the Red Ball envelopes. When a break occurs in a series, two series are used in the report, the first terminating with the number preceding the missing symbol.

A similar report is used in reporting arrival at destination, or at junction points where cars leave the company's rails, or at company junctions, with the exception that freight destinated to local and branch-line points is followed only to the district terminal or branch-line junction point. It then becomes the duty of the Division Superintendent and agent to see that such cars are forwarded to their destination on the first proper train, and that this arrives at destination as nearly on time as possible.

Red Ball freight at intermediate stations—i. e., stations between district terminals—is forwarded to the first district terminal by local train to be switched at that point into proper Red Ball trains. Agents at non-Red Ball billing stations, having cars entitled to such billing, wire the agent at the first Red Ball billing station on the route of the car, and upon its arrival at such station the car is handled in the same manner as if originating at that point. Local merchandise-cars traveling as Red Ball freight are Red-Balled to the last district terminal reached before distribution begins. Agents at such terminals must then see that the car is promptly forwarded. Agents at district terminals are required to scrutinize all waybills, to discover whether or not any shipments are entitled to Red Ball service.

The movement of Red Ball trains, as has been suggested, is under the direction of the General Superintendents, but each superintendent is required to notify connecting divisions of the movement of all such trains or cars destined for such divisions. Diversion of loaded cars in transit is handled by the Freight Claim Agent, the station agent who makes the diversion wiring the General Superintendent of his district the new consignee, destination, and routing.

As the entire movement of these trains is reported by wire, it is necessary to prohibit the tracing of shipments by wire except in cases of very urgent importance, on the theory that the tracing has no effect upon the movement of this class of freight, tracers being regarded merely as requests for information as to location, movement, or arrival. All such tracing is handled through the Assistant to the Second Vice-President. All telegraphic tracing is done by code, the inquiry being made of the General Superintendent most likely to have the car. If he does not have the car, he passes the inquiry to the General Superintendent to whom it has gone, wording his message in such form as to make it clear who it is that wants the information, and answer is made directly to the person making the initial inquiry.

Where the destination of the freight is beyond the company's rails, delivery to connection is reported, followed by a report of the arrival at its ultimate destination, if desired, by mail. Trains are given a symbol letter, according to their points of origin and the dates on which they depart, and are known through to their destination by these symbol letters.

PER DIEM AND CAR SERVICE RULES: THEIR MEANING AND APPLICATION

"Per diem," generally speaking, is car service charged one railroad by another for the use of its cars; "car service" is per diem charged the public by the railroad for the use of cars. While to a certain extent interrelated, per diem and car service must, for the sake of clearness, be treated separately.

From the beginning of railroads in America up to 1902 the only compensation a railroad received for the use of its cars by another railroad was upon a mileage basis, except in a few isolated instances where a per-diem rate was tried as an experiment by one railroad with another. The rate generally charged in the beginning was one and a half cents per mile, with no allowance for empties. There was, however, no uniformity, railroads charging one another what they pleased. Later on, in the seventies, this rate was lowered to one cent per mile, loaded or empty; then to three-quarters of a cent; then to six mills; and, finally, in 1892, by agreement of the roads forming the American Railway Association, it was fixed at three-quarters of a cent per mile. Under this arrangement, however, when a car was not being hauled no charges were accruing against it. There was, therefore, every incentive to keep foreign cars from moving, even to haul them back to their home tracks. They made excellent warehouses and could be stored away on sidings indefinitely. It also rested entirely with the company using the car as to how many or how few miles it should report on any car. Although it was considered a matter of honor to report mileage accurately and honestly, it has been proved in many instances that railroads did cut their mileage reports. One railroad in New England, it has

been shown, held out $80,000 per year in mileage. No railroad permitted another to inspect its books to see whether or not accurate reports were being turned in; there was therefore no remedy; and the excuse for reporting short mileage was that "the others do it too."

Once a car got off its home line it might be years before it was returned. Many cars were reported on the books "lost." Railroads had men doing nothing else but going up and down different lines searching for cars. In time of car scarcity this practice was a hardship on all lines, as well as upon the public. While with a small road having few cars it was cheaper to pay mileage on cars than to own them, on a large road this was not true. The object of per diem was primarily to encourage the movement of cars. In 1900 the average run of a freight-car was only about twenty-four miles per day. This made the revenue from each car but 18 cents per day, and the total revenue from each car on a foreign line $65.70 per annum. The average cost of repairs per car of twenty-seven different railroads at that time was $43.53 per annum. Master Car Builders' rules allow 6 per cent. per annum for depreciation. On a car costing $800 this meant a charge of $48 per year, making the cost of ownership of a car $91.53 per annum. This left a deficit of $25.83 to be made up from equipment fund or otherwise. Clearly, with an average mileage of twenty-four miles per day, at a cost of three-quarters of a cent per mile, the result was not remunerative to the railroad companies. There was no means of *forcing* the cars to greater mileage.

In 1876 Mr. J. T. Rigney, the car record officer of the Baltimore & Ohio, first advocated a per-diem plan, but his proposition was not taken seriously, being considered

impracticable. The per-diem method was tried subsequently by different railroads among themselves, at varying rates, simply as an experiment. Though generally denied that the per-diem charge is in any sense a "rental," it was argued that a car, like a house, represents money invested, and the fact remained, whether the car was in use or not, that the owner was deprived of its use when it was on a foreign line. The mileage basis is analogous to a case where a man rents a house, but declines to pay rent when he is not actually using it. A thousand cars represent an investment of at least $800,000, and a railroad company which has upon foreign lines one thousand of its cars (and this is not at all unusual) has the same as loaned $800,000. What railroad would loan this amount in cash without adequate security and without assured interest? It is true that it was and is today the practice to keep as many foreign cars on the home lines as there are home cars on foreign lines, but this is only a means of getting around the question and was not in any sense a solution of it.

In 1900, through the influence of Mr. J. W. Midgley and a number of large railroads, the Bureau of Car Performances and Statistics was organized to investigate this question of per diem and mileage, and, if possible, to arrive at a solution of the problem. After overcoming many difficulties in the way of prejudices, jealousies, and so forth, the per-diem rate of 20 cents per car per day, with a penalty charge of 80 cents, described more in detail below, was evolved, and was adopted April 24, 1902, by the railways comprising the American Railway Association.

Briefly, the per-diem rules are as follows: Twenty cents per car per day must be paid for every calendar

day a car is in the hands of a foreign line, the day of receipt of car being disregarded, but payment being made for the day of delivery. A road has the right to demand the return of its car after it has been twenty days consecutively on any road. If the car is held by such road more than ten days after the date of the penalty notice (thirty days in all), thereafter a penalty rate of 80 cents per day in addition to the per-diem rate of 20 cents must be paid for the further use of such car. All railroads and ferry lines are responsible to the car-owner for amounts accruing for the use of such car, whether in road or switching service, until the car has been delivered to the owner or to another road; but an arbitrary amount for each car in switching service may be reclaimed by the switching line *from the road for which the service was performed,* such amount to be fixed for each local territory by agreement between the roads interested. (For instance: A Baltimore & Ohio car is delivered to the Atchison, Topeka & Santa Fé by the Missouri Pacific at Newton, Kan., to be switched to a mill for loading and returned. The Missouri Pacific reports to the Baltimore & Ohio delivery of the car to the Atchison, Topeka & Santa Fé, and per-diem charges against the Missouri Pacific for such car cease and begin against the Atchison. The car being delivered within the yard at Newton, the Atchison gets no division of freight earnings, but simply an arbitrary switching charge from which have to be subtracted the per-diem charges accruing daily which the Atchison must pay. This is manifestly unfair, and the Atchison is allowed to make reclaim against the Missouri Pacific of, say, 40 cents, the average time required for such switching service having been determined and fixed at two days.)

A road is responsible to the owner for an amount equal to the per diem accruing on any empty car delivered without the consent of the owner to a road which does not pay per diem; this is also the case where a road permits the loading or reconsigning of a foreign car without the consent of the owner. Reclaim is usually allowed on account of defective cars, and, when a car is detained awaiting receipt of necessary repair material from its owner, per diem ceases from the date such material was ordered until the date received by the road holding the car. When a car has been destroyed, or so damaged as to require an appraisement, or a home route card has been requested under the Master Car Builders' rules, the per-diem charge ceases from the date of notice to the owner. Under these last two rules it is necessary that the Car Accountant should be immediately advised of all cars delayed, and the advice should show whether the cars are destroyed or damaged, and should contain such other information as will enable prompt and accurate reports to be made to the owners.

The "interchange report" closes daily at midnight and includes a list of all cars exchanged upon the date named, unless otherwise noted: reports are required to be made to the car record office on each day, whether cars are exchanged or not. Where there are different standards of time at junction points, the earlier time must be used. These reports shall be upon the prescribed form, giving station, date, car numbers, and initials, marked with a "x" or "—" to indicate whether loaded or empty and must be signed by the agents, or other authorized representative or representatives of both roads. The time of delivery of cars upon interchange tracks of connecting lines shall be the time given by the delivering road. Four

copies are made of this report. Agents of both lines sign, and two copies are then delivered with the cars, one copy is retained for the agent's file, and one is sent to the car record office. For cars received the report will be made by the agent of the delivering road and the two copies received with the cars handled in the same manner —one copy for the file and one for the Car Accountant. Report of delivery to each road is made separately. The junction report for each day is made by the Car Accountant of one road to the Car Accountant of another as soon as possible after the receipt of the interchange report, and shows receipts and deliveries.

Within thirty days after the end of each calendar month car-owners must be furnished with a per-diem report for that month on the prescribed form, showing the number of days each car has been in service upon the road making the report. This report is made by the Car Accountant to the officer designated in the Equipment Register as the proper person to whom such reports should be sent. Remittance is made to such officer, and is usually by balance instead of by exchange of drafts. The penalty notice, which is printed in red, is served by one Car Accountant on another. It is sent in duplicate, one copy being retained, the other signed and returned. The notice states that the cars therein mentioned have been on the line of the road served twenty consecutive days, and that, if not disposed of within ten days, penalty of 80 cents per day per car will be charged. Car numbers and initials are given with dates and places of delivery, and provision is made for reply, showing disposition and date, opposite each car enumerated, in case the report is disagreed with.

In case a road fails to receive promptly from a connec-

tion cars upon which it has laid no embargo, it is responsible to the connection for the per-diem charges on such cars so held for delivery, including the home cars of such connection. If such failure continues for more than three days, the delinquent line is thereafter in addition responsible for the per-diem charges on all cars, wherever in transit, which are thus held back for delivery, reports of which, giving initials and numbers when desired, are to be made daily. In case notice of an embargo is given by any road, cars already loaded with such traffic at the time such notice is issued are to be received. In case of refusal the road is responsible for per-diem charges for the number of days such cars are held, not exceeding the duration of the embargo. After the date of the notice a road must not load or reconsign cars in such traffic to the road issuing the notice. All such notices are to be given by wire to immediate connections, and by them transmitted as may be necessary. Provision is made for an arbitration committee of five members of the American Railway Association, to whom disputes are to be submitted. These rules do not apply to private cars.

"Breaking penalty" constitutes getting a penalty car off one's own line. This is sometimes accomplished by delivering to a subsidiary line and reporting to the home line, such subsidiary company redelivering the car the next day perhaps. When penalty is broken, the 20-cent rate only applies, for penalty cannot follow a car to another line. This practice of escaping penalty is discouraged by the American Railway Association, which has endeavored to provide against it by ruling that certain named railroads shall be considered portions of one rail-

road, and that delivery to or from any part thereof to another shall not constitute delivery to another line.

Under this head also may properly come charges for exchange of passenger equipment. According to the American Railway Association code of rules, adopted October 24, 1900, and as in effect January 1, 1906, "the following rates for the use of passenger equipment shall be in force, unless otherwise arranged between the roads concerned": (*a*) The rate for coaches, dining-cars, chair-cars, parlor-cars, combined passenger-cars and postal-cars, shall be three cents per mile of actual distance; and for baggage-, express-, mail-storage, combined baggage-express, baggage-mail, and baggage-mail-express cars, one and a half cents per mile for actual distance. These rates shall apply when owners of cars participate in the business, and not when cars are hired to other lines. (*b*) The per-diem rate for coaches, dining-cars, chair-cars, etc., hired at other than mileage rates shall be $5 per day; and for baggage-, express-, mail-storage, etc., cars, $3 per day, subject, however, to agreement between the parties interested. Fractions of a day are counted as one day. When necessary to haul cars empty over the roads owning them, or intermediate roads, for delivery to the borrowing road, the tariff rates for such cars shall be charged the borrowing road for hauling cars from the points where they left service to the points of connection with the borrowing road and return, the charge for the empty haul being named to the borrowing road at the time the agreement to loan is made.

At the last meeting of the American Railway Association it was agreed to raise the charge per diem from 20 to 25 cents, the penalty charge being reduced to 75 cents. This rate is at present being ratified by the various roads

comprising the association and will go into effect when this has been completed. I am also informed that it is expected that the rate will in the near future be raised to 30 cents, the penalty rate being lowered to 70 cents, the opinion being that this is nearer an equitable charge for the use of a car and one which will tend to promote greater activity. At the time of going into effect of the present per-diem charge the increase in the activity of freight-cars was remarkable. The charge touched the pocket-books of the various roads, and cars which had been struck off the books as lost appeared from the most unlikely places and were rushed home. The saving to the railroads was enormous. Instead of having to buy new equipment, the railroads found that they already owned enough—in some cases too much. In 1902 there were approximately a million and a half freight-cars in use in the United States. If the activity of these cars was increased 10 per cent., it would be equivalent to having 10 per cent. more cars. This alone would save an expenditure of approximately $1,500,000. The average freight earnings per car per day at that time were about $2 (though in some cases they rose as high as $7) ; and this would mean, at $2 per day, $1,095,000 per year in addition. At the time of the adoption of the per-diem rate there was and had been for some time a severe car famine, and the resulting car "plenty" made the advantages of its adoption, if possible, more prominent.

It may be pertinent to suggest that it seems hardly fair for a railroad to be charged the same rate for a car of 30,000 pounds' capacity as for an 80,000 pound-capacity car. One cent per ton capacity per day would seem equitable.

Another thing which may be here brought up is the

question of equipment pools, or of a clearing-house of freight equipment, or of freight and passenger equipment. There are in the United States today about two million freight-cars—sufficient to provide for all requirements of traffic conditions for some time to come, if properly distributed and handled. While per diem works very well as a general rule, and is in any event far superior to the mileage method, it is true that for roads near large commercial centers in times of car shortage it is much more profitable to pay per diem than to own cars, and the result is that the smaller roads suffer—in fact, all roads get a taste of the same thing at different times. There is an American Railway Association rule which requires the reloading and reconsigning of a foreign car in the direction of home; but this is frequently violated, however, in case of car shortages. The only thing that can be done is to "kick," and this is done vigorously. The car-pool scheme would obviate this; but it has the objection of placing the control of all the equipment in the country into the hands of one man or perhaps a committee. Jealousies and dissentions among the roads would make it a constant source of complaint. It seems really too large a scheme and puts too much power into the hands of one man, though it might be practicable if the country were divided into districts, similar to the various passenger associations, and handled by district distributors under a general manager.

Per diem has done much to unite the railroads of the country and to show them the advantages accruing from co-operation, and it may be that ultimately such a bureau will be put into operation. The Union Pacific, Southern Pacific, Oregon Short Line, and Oregon Railroad & Navigation Company have done so among themselves, pooling

all their equipment, and the results have been found to be excellent, showing an enormous saving in empty-car mileage and a considerable increase in loaded-car mileage. An example of what can be done in the distribution of equipment from a "pool" is given by the Pullman Company and the Armour Car Lines.

It will be noted that private cars are exempt from the payment of per-diem charges, this being for the reason that they have refused to enter the per-diem agreement because their remuneration under such would not be sufficient. A private car travels for the most part in trains that run on almost passenger schedules, covering 350 to 400 miles per day. Private car lines charged one cent per mile west of Chicago and three-quarters of a cent east of Chicago, at the time of the adoption of per diem. It was agreed among the railways to reduce this payment to a half cent per mile. The result was that the car lines, which are the largest shippers themselves in the country, declared that they would pick out the smallest and weakest lines wherever possible and route everything over them; and this they did. The larger roads could not stand the loss of revenue, and one by one they all came to terms. At present the rate is regulated by private agreement, but is for the most part three-quarters of a cent per car per mile east of Ogden, Utah, and one cent west thereof, loaded or *empty*.

"Car service"—or "demurrage," as it is popularly known—is the charge made by a railroad company to a consignee for the use of a car in excess of a reasonable time—usually forty-eight hours, though in some states different lengths of free time are required by statute.

Car-service associations are formed by mutual agreement among railroad companies operating in a stated

territory. They owe their existence to the growth of the business interests of the country, the enormous increase of through-freight handled, and the consequent extension of the railroad systems handling the same. The continuing increase in the volume of the freight brought into any section from distant markets, hauled without unloading over the tracks of connecting systems of the same gauge, made it more difficult for each carrier to keep track of its own cars. As the cars of each system were handled indiscriminately by every other system, they soon drifted to every quarter, as the current of traffic ebbed or flowed, and their whereabouts were often unknown to the carrier owning them. To correct this evil, car-service associations were formed, so that each system might receive compensation for the use of its rolling-stock and no unfair advantage taken by one system over another in the collection of such compensation, and to prevent cars standing idle at one place when needed to meet the traffic demands of another section of the country.

These organizations had a beneficial effect in preventing congestion of empty and idle cars at one point, while a car famine prevailed at another. But it soon became apparent that the remedy was not complete. Carriers earn money by the moving of freight, and the idle car produces no revenue. The associations found that, while it was possible under the then existing rules to keep the unloaded cars moving from place to place as necessity might require, they were without power to have the freight promptly unloaded by the consignee, thus securing the car for further service. The merchant was ordinarily anxious to get his goods from the car upon his shelves; but the broker and commission merchant, who do large business with limited or no storage facilities, found it

very convenient to use the cars in which their goods came as warehouses, and thus await the possibility of a favorable fluctuation in prices, when the commodity could be disposed of to advantage, and the car either unloaded or rebilled. To meet this contingency, the demurrage rules were formulated and promulgated, and the demurrage charge was agreed upon.

The purpose of the car-service associations is not to make money themselves; they make money for the roads only incidentally by keeping every car in active service. Their prime object was to conserve and promote the mutual interests of the carriers and the public by improving the service of the Traffic Department and insuring the prompt handling of freight. Different parts of the country and different commercial centers are covered by different car-service associations (thirty-seven in number), and it is their duty to see that no favoritism is shown in the assessment of demurrage charges; that collection of all charges is made; that relief from charges is given under certain circumstances, such as heavy storms, bunching of cars in transit, etc. These associations receive daily reports from all stations in their jurisdictions of all cars upon which demurrage is accruing; and, to see that this is done without subterfuge, they have inspectors traveling about, noting car numbers, and then comparing with the agents' reports the results of their own observations.

The rules of the Chicago Car Service Association, which is composed of the roads entering Chicago and which contains about four hundred stations, is representative of car-service association rules as a general class, for, with some exceptions which I shall mention,

and others which grow out of local conditions, they are all about the same. Briefly, these rules are as follows:

Freight in carload lots is allowed 48 hours' free time for loading or unloading, or, when the same car is reloaded, 96 hours are allowed, after which $1 per day is assessed for the holding of the car. Forty-eight hours are allowed for the reconsignment or switching orders, but this does not apply when cars are moved from one delivery track to another for the accommodation of consignees. Freight in bond is allowed 48 hours' free time for removal from the first 7 A. M. after permit to receive the goods is issued by the collector of customs. Freight held for billing, milling, shelling, etc., or for change of load by the owner or his agent, is allowed 48 hours' free time, and if transferred to other cars the charge will continue and must be collected or billed as advances. On cars billed to order, demurrage charges must be collected before delivery of the freight. Time is computed from the first 7 A. M. after notice of arrival is given; if delivered to private tracks, after the cars have been placed. There are practically 300 car-service days in the year, certain holidays and Sundays being excluded.

Grain in bulk is allowed 48 hours' free time, from 12 o'clock noon of the day of arrival, if it is inspected before 10 A. M. of the same day; if not, from 12 o'clock noon of the next day. Grain ordered to elevators will be held for 5 days from the first 7 A. M. after orders are filed with agent. I am also informed that an allowance of 5 days is made after inspection for the filing of orders. Grain from connecting lines will be held 48 hours free from the first 7 A. M. after receipt of cars by the secondary line for the placing of final billing directions. Cars for loading at elevators are allowed 48 hours' free time. The reason

given for the allowance of 5 days *after* the filing of orders on grain for elevators is that an elevator is devoted to public service—that is, it cannot regulate shipments to it, it must take everything that comes—and that it would be a hardship to force it to pay demurrage when a rise in the market had filled the elevator's tracks with cars loaded with grain. Then the elevator must load cars too, and there is, of course, a limit to its capacity.

On baled hay and straw 48 hours' free time is allowed after being placed on the track in the delivery-yard for the placing of orders, and 48 hours' additional time is allowed for unloading after the order is filed at the local office for disposition. This is for the purpose of allowing inspection of the contents of the cars; for the tendency of shippers is to put the best hay and straw, as the case may be, nearest the door. A passageway is cleared out lengthwise through the middle of the car for the purpose of such inspection by the agents of the Hay Receivers' Association, who are the wholesale commission men in this line. This operation is called "plugging" and cannot be done in an outside yard, so the car must be brought to the team tracks.

Cars loaded with coal or coke may be held on the storage tracks of the railroads for 5 days, but must be unloaded within 48 hours after being placed on the team track. The reason for this is that, in large centers, it is necessary for coal dealers to keep a certain quantity of coal in reserve stock; coal, too, is very low-grade freight and, on account of the low rate at which it is hauled, is subjected to many delays by railroads, which results in bunching in transit. In order to offset these things, the allowance of 5 days is made.

When cars are held for payment of freight charges,

demurrage is assessed after 48 hours from the notice of arrival. Cars are not exempted from payment of demurrage by reason of the consignee not being able to receive them, and only in cases of especial hardship are these charges canceled by the manager of the association. If a consignee is unable to receive the freight or to unload the cars, and for that reason the delivering line refuses to receive cars from a connecting line consigned to such consignee, the agent of such connecting line holding cars for such consignee must immediately notify either the consignor or the consignee of inability to deliver such cars, and demurrage shall be charged if delivery cannot be effected within the time allowed for reconsignment. When both cars and tracks on which cars are held are owned by the same party (not a railway company), no charge is made; but when private cars are detained on tracks operated by a member of the association, the car-service charges apply.

Storage is charged when freight is unloaded at railroad warehouses or platforms and is not removed within 48 hours after the first 7 A. M. after notice. Freight in cars placed on delivery tracks, and subject to demurrage charges while on such tracks, if subsequently unloaded and sent to railroad warehouse or platforms, is then subject to storage charges. Freight received for shipment, and held for directions or to complete a shipment, will be charged storage after the first 48 hours from the first 7 A. M. after receipt. The storage charges in use in the Chicago Association are, on less-than-carload freight, 5 cents per ton per day after the first 48 hours, and this applies whether the freight is in a warehouse or in a car. On carload freight in a warehouse the same rate applies, but only when in the warehouse. Some kinds of freight,

such as glass and glassware, do not under any consideration take the carload rate, their lightness and bulkiness making it impossible to load a car to its full capacity. Such goods are charged storage rates under all circumstances, whether in a car or a warehouse.

Car-service charges must be collected regardless of weather conditions, unless exemption is authorized by the manager of the association. Live-stock and company material are exempt from car-service rules. Live stock is always unloaded immediately at destination and cannot by law be held over 28 hours without unloading. Hence, any regulation by the association would be ineffective. Demurrage and storage charges are to be collected in the same manner as transportation or switching charges, and freight upon which car service has accrued is not allowed to be removed until charges have been paid. When payment is refused, the agent must hold the freight and assess regular charges until removed, or he may send the freight to a public warehouse or yard, where it will be held subject to storage charges. When cars are detained on private tracks beyond the free time, and payment of demurrage is refused, the agent of the company delivering such cars, after giving five days' notice, can decline to switch the cars to the private tracks of such parties, and will thereafter tender freight from public team tracks and collect freight charges before delivery, as well as any demurrage which may have accrued on such shipment. Notice of the arrival of the car or shipment is given, but not of the commencement of demurrage charges. The average detention of cars is not recognized.

Notable variations from these regulations may be noted as follows: By statute the roads comprising the New England Car Service Association are required to allow

96 hours for unloading and loading each car. In Missouri and Kansas 3 days' free time is fixed by statute. The Terminal Dispatch Association of Minneapolis allows but 24 hours for loading or unloading. Only one other association (the New England Association) allows 96 hours for sampling hay and straw. Out of thirty-seven associations, four allow 72 hours for storage of coal and coke, one allows 96 hours, and one (the Chicago association) 5 days. Five allow seventy-two hours on "furnace materials." Three allow seventy-two hours on paving material. Two allow 72 hours on lumber. One allows 72 hours on lime. The Texas Car Service Association has no limit on elevator grain. One association allows 72 hours on fruit and vegetables; one, 96 hours, and one, 120 hours.

In the "Rules Relating to Storage, Demurrage, and Car Service of the State Corporation Commission of Virginia" provision is made for the payment by the railroad company of $1 per day for failure to supply cars when requested, excepting for coal and coke shipments; also that shipments must be received immediately by agents when presented, and carried forward at a rate of not less than fifty miles per day. For failure to do so $1 per day shall be charged against the railroad by the shipper, or 1 cent per 100 pounds per day, with a minimum charge of 5 cents per day, "upon demand in writing by the shipper or other party whose interest is affected by such delay." A period of 24 hours is allowed for rehandling or transfer. Companies are liable to a charge of $1 per day for failure to give notice of the arrival of a shipment. The railroad company must place cars in "accessible" places for unloading, under the same penalty. Provision is made for payment of demurrage to the rail-

road company when cars, ready for loading, are held on the loading-track more than 48 hours, but the railroad company must consider cars released if held in excess of 48 hours over the 48 hours' free time—thus limiting demurrage chargeable for loading cars to $2. Railroad companies cannot be required to furnish cars to parties in default of demurrage charges. Provision is also made for allowance in case of irregularity or bunching in the furnishing and delivery of cars. It is also provided that a consignor or consignee five miles or more from a depot shall not be held liable for storage or demurrage charges until "sufficient time" has elapsed after notice to remove or unload the goods, such time limit not to exceed five days, however. Ten days' free time is granted to coal. Private cars on private tracks are exempted from the rules.

These rules are given simply to show the present practice in different parts of the country, and are continually being changed in one respect or another.

The history of the demurrage charge and the car-service association is interesting. Previous to 1888 no systematic method of applying car-service charges was employed. The railroads had so-called "demurrage rules," which they applied usually to the small shippers. The charge was from $1 to $5 per car per day. In the early seventies a suit against the Chicago & North-Western on account of excessive demurrage was decided against the railway company. On November 1, 1888, in Chicago, the first car-service association was organized to bring about uniformity in practice. This was the result of a meeting of the General Time Convention, the predecessor of the American Railway Association. A charge of $1 per car per day was agreed upon, irrespective of the ca-

pacity of the car. At that time $1 per car per day was an equitable charge, but now, with the increased capacity of cars and with their increased earning power, $1 per day has ceased to be a sufficient charge, if remuneration of the company for the use of the car is desired. The average earning power of a car is about $2.75 per day. On account of repairs, depreciation, and interest charges, it costs about 50 cents per day simply to own a car. In addition to the loss to the company of this $3.25 per day for each day a car is kept out of service, there is the loss to the public of the advantage gained by the use of the car. A car is a public utility, and anyone using up or monopolizing such should pay a penalty. Especially in a large terminal, where the land is worth many hundreds of dollars a foot, is it true that $1 per day is not a sufficient charge.

Demurrage charges have been the subject of much litigation, and there have been a number of attempts to have the charge made statutory. However, it is so well recognized as being a proper charge that the right to make such a charge is now never questioned. There have been some attempts to enforce and to provide by statute a reciprocal demurrage—something similar to that practiced in Virginia, referred to above; and there have been a great many arguments advanced for and against; but it does not appear that there is any real reciprocity in an arrangement whereby shippers would receive pay for all delays above what may be predetermined as a reasonable amount, incident to the as yet unperfected business of railroading, and as an offset to the charge levied by railroads for the use of their equipment by shippers beyond the reasonable time for loading or unloading. In one decision the demurrage charge is defined as "in its essential char-

acter a charge for storage." A charge levied on the railroads would be a *penalty* for delays, in the nature of a fine, and would pay for no service. On the other hand, a shipper always has the option of a recourse to the courts for damages suffered on account of delays to shipments due to negligence, etc., of the railroad.

Cases bearing on different aspects of car service and the demurrage charge may be mentioned:

In the case of Kehoe & Co. vs. the Charleston & Western Carolina Railway Co., before the Interstate Commerce Commission, objection was made to the amount of demurrage charged. It was contended that the cars in which the shipment in question was transported, were owned by a railroad company other than the one assessing the demurrage charges; also that the railway delivering was charging $1 per day on a car for which it paid only 20 cents per day. The defendants answered that the 20 cents per day was not supposed to be a rental, but was "an arbitrary sum agreed upon among the various railroads for the purpose of settling car accounts with each other," and showed that the rental value of a car was much greater than $1 per day—that its earning power was approximately $2.25 per day. It was argued by the plaintiff that the former price paid for foreign cars was three-quarters of a cent per mile, which price was subsequently reduced to six mills per mile, and that, if railroads had been operated upon a compensatory basis up to three years prior to that time, why had they fixed a sum which was not supposed to be a compensation; that the fact that private cars were paid mileage rates led to the same conclusion; that cattle-cars were paid for at the rate of three-quarters of a cent per mile, and this was found remunerative because "railroad companies

would pay shippers a premium out of the wheelage charges for the use of their cars;" at six mills per mile it was not extremely profitable. In the decision it was stated that it was to be noted that while a car is in service it is depreciating in value; that the question was not whether the charge was a reasonable sum; that it was the duty of the carrier to transport freight to its destination and to deliver it to the consignee, and the duty of the consignee to receive the freight within a reasonable time; that, if he neglected to do so, the railroad company's liability as a carrier ceased and it became simply a warehouseman and might insist upon the consignee receiving and removing the freight; that it would be not only embarrassing but impossible for railroads to handle freight if terminals were congested by cars which were awaiting unloading; that the demurrage charge was a penalty, but that it was not a hardship and was sufficient for the purpose intended.

It was held in Pennsylvania, in the Millers' State Association vs. the Philadelphia & Reading Railroad Co. (8 *I. C. C. Rep.* 531), that forty-eight hours was a reasonable time for unloading.

In the Blackman cases (10 *I. C. C. Rep.* 353) it was held that the Southern Railway might apply for interstate business the same storage rates as those prescribed for state business, and that such rates were reasonable, although much higher than those charged by warehouses for the service of storage.

The cases of the Baltimore & Ohio Railroad vs. Gray's Ferry Abattoir Co., appellant, in the Superior Court of Pennsylvania, and of the Pennsylvania Railroad Co. vs. the Midvale Steel Co. (201 Pa. 624), are authorities that establish the right of a carrier by rail to enforce a rule fix-

ing a reasonable charge for unloading without special notice to shipper or consignee. The court in its opinion says: "The plaintiff has an unquestionable right as a common carrier to make reasonable rules to speed the unloading of its cars. Cars are for the transportation of freight—not for storage;" and that "the rule is manifestly a reasonable one both as to time and charge."

The Railroad and Warehouse Commission of the State of Minnesota states, in its opinion in the case of the Board of Trade of St. Paul vs. The Terminal Dispatch (Car Service) Association, that "neither railroad companies nor shippers have the right to use railroad cars for storehouses."

Baldwin's *American Railway Law* (1904, p. 357) says that

a rule imposing a demurrage charge of a reasonable sum, such as a dollar a day for loaded cars which the consignee fails to unload within forty-eight hours after arrival, is a reasonable one. Cars are designed for vehicles—not storehouses. Such a rule enters into the contract for shipment, and, if it has properly been made public, binds all consignees, though without actual notice of it.

In the case of a shipment of armor plate to the Union Iron Works at San Francisco, the Atchison, Topeka & Santa Fé Railway Co. billed against the government for $12 demurrage for failure to unload. The payment was refused on the ground that the Iron Works were at fault in not unloading. The Comptroller of the Treasury in his opinion states that

the armor plate with which the cars were loaded was the property of the government and continued all the time in its ownership; the contract for carriage was between the United States and the railway; the Union Iron Works was not known

in the transaction, and there was no privity of contract whatever between it and the railway company. For these reasons I am of the opinion that the United States is liable for the demurrage charged. . . . . I am of the opinion, further, that as it was the duty of the Union Iron Works to unload the cars at its own expense, and as it was without fault of the government, but was caused by the congested condition of the Iron Works yard, it is liable to the United States for the damages caused by the delay.

In the case of the Thomas Phillips Co. vs. the Erie Railroad Co., in the Circuit Court of Summit County, Ohio, the railroad company was sued for damages accruing because of failure to deliver cars to the plaintiff on its private track. The defendant, it seems, had delivered a number of cars on such private siding, and payment of demurrage charges accruing on some of them was refused. The defendant, according to the rules of the Cleveland Car Service Association, notified the Phillips Company that until such demurrage was paid it would deliver only on public team tracks. It was held by the court that such rule was "just and fair in order to secure the speedy unloading and return of cars, and to avoid detention thereof by shippers and consignees."

In the cases of the Kentucky Wagon Manufacturing Co. vs. the Louisville & Nashville Railroad Co. (98 Ky. 152), and of Bowen & Schumacher vs. the Chicago & North-Western Railroad Co., in Illinois, this conclusion is also borne out: that the failure on the part of a consignee to unload a car within a certain time works an injury to the railroad, for its car is thereby for the time being put out of use; it works an injury to the consignors for the time being, for the reason that it loses the benefit of such car when there is a congestion of traffic; that it requires very strict rules to keep cars moving, for the tendency on the part of shippers or consignees is to forget

about the car that is awaiting loading or unloading; that it is well founded in law that the lien for storage charges is a right to retain possession of the goods until the satisfaction of the charges imposed.

In the Supreme Court of Mississippi, in the case of the New Orleans & North-Eastern Railroad Co. vs. A. H. George & Co. (35 *So. Rep.* 193), in 1903, the right of the railway company to hold goods from delivery on private track until demurrage charges were paid, and even to sell all or part of the shipment to pay such charges after a considerable time has elapsed, is held.

It is also held that, even though a party may be unreasonable in refusing to deliver goods upon which he has a lien, and even though he charges more than he is entitled to, the lien is not defeated unless the owner or party desiring the possession of the goods makes a tender of either the amount due or what he deems a reasonable amount. (William A. Russell vs. Balthaeser Koehler, 66 Ill. 459; Lowenberg vs. Arkansas & Louisiana Railway Co., 19 S. W. Rep. 1051; and others.)

The right of the railroad company to recover charges for the detention of cars by consignees after a reasonable period after they are placed for unloading is established by the following cases: Worden vs. Remis (32 Conn. 268); Kentucky Wagon Co. vs. Louisville & Nashville Railroad Co. (11 *Ry. and Corp. Jour.* 49); etc., etc.; and in many other states in the eastern, south central, and western parts of the country.

The lien of the railway company for unreasonable detention and use of cars is established by Norfolk & Western Railway vs. Adams *et al.* (90 Va. 393); Ellcott on *Railroads,* secs. 1567, 1568; Miller vs. Mansfield (112 Mass. 260).

INDEX

INDEX